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TUNGSTEN LAMPS OF LOW CANDLE POWER.

An idea seems to be prevalent in some quarters that tungsten lamps for 110-volt circuits of lower candle-power than the 25-watt 20-cp lamps regularly manufactured in this country would be desirable. The need for tungsten lamps of less than 20 cp for 110-volt circuits is very questionable at this time. It certainly cannot be maintained on grounds of economy that for use in out-of-the-way places, such as closets and hallways, lamps of low candle-power made of tungsten are much to be desired. Where lamps are used infrequently it is hardly worth taking the additional risk of breakage and paying the extra cost of the tungsten lamp to secure the very small saving in operating expense over carbon filaments until the smaller candle-powers of tungsten lamps are very much less expensive and fragile than at present. The use of the tungsten lamp in general will at present be confined to places where lamps are operated a considerable number of hours per year, and in most of such locations lamps of more than 20 cp are desirable with our rapidly increasing ideas of what constitutes sufficient illumination. For general use in residences and offices, there is really no good reason for a lamp less than the 40-watt, 32-cp size. The short-bulb, 40-watt tungsten lamp can be used in practically all sockets where 16-cp carbon-filament lamps have been used heretofore. They will give double the illumination with less power consumption, and for the general lighting of any ordinary room, nothing less than 32 cp is needed. The central-station industry missed a great opportunity which attended the coming of the metallic-filament lamp by failing to insist that advantage should be taken of the occasion to raise the unit electric light to the gas-mantle standard. The tungsten candle-power standard should have been 40 watts; the lower rating of 25 watts is distinctly disadvantageous to the central-station industry, which should not only resist any further lowering of tungsten candle-power, but should unite in a movement to make the 40-watt lamp the standard.

20,000-KW GENERATORS.

The announcement that the Commonwealth Edison Company of Chicago has purchased a new site for huge generating stations in the northwestern part of that city is one of much interest. On the land which has been purchased, a portion of which abuts on the North Branch of the Chicago River, will be erected, eventually, two generating stations, each to have a rating of 120,000 kw in electric generators. Work will be begun on one of these within a few weeks, the initial installation being for 40,000 kw, although about half of the turbine-room will be built at once. The turbo-generators installed in this plant will have a continuous rating of 20,000 kw each and will be much larger, in point of output, than any generating units now existing. The machines will be of the vertical type, each one being placed over its condenser, and three-phase, 25-cycle alternating currents will be generated at 2300 volts. Ventilation of this great alternator will be obtained by means of an air-duct leading to the top of the machine, as in the case of the 14,000-kw units at the Quarry Street station in Chicago.

Twenty-thousand-kilowatt generators, driven by steam turbines, have been predicted, but the new Northwest station in Chicago will see the first actual installation. The growth in size of output of electric generating units since the advent of the steam turbine in power-house design has been phenomenal. It is only between six and seven years since the first 5000-kw turbo-generator in the world was put into service at the Fisk Street station in Chicago, the installation of which machine marked a revolution in power-house design. The use of steam turbines and large generators was found to result in a marked reduction in the cost of making electricity, and soon improved types and larger sizes were available, until, in 1908, five years after the first Fisk Street unit was put in service, 14,000-kw turbo-generators of similar design were put into commission in the still unfinished Quarry Street station the neighbor of "Fisk Street." And now, this year of grace 1910 is early signalized by the beginning of work on a new station—one of twins—on a new site several miles distant where 20,000-kw turbo-generators will be installed. Thus in less than eight years the maximum size of electrical generating units will have been increased 300 per cent! Truly this is an age of big things.

The 5000-kw unit planned in 1902 and the 20,000-kw unit planned in 1910 were not designed and erected merely to be big. They were designed on sound engineering principles to fit into the progress of an art whose continued extension depends largely on the ability to make electricity cheaply. They have proved economical and so are useful. It is fitting to remark that it took no small degree of courage in 1902 to install a 5000-kw steam-turbine unit, all untried, in a great electric-service system intimately connected with the life of a great city. Perhaps it took more boldness to say "Go ahead!" in 1902 than to tell the manufacturers to make a 20,000-kw unit in 1910. But the same man made the decision in each case—a man to whom the electric-service industry in the United States owes a debt of gratitude for a boldness, an initiative, an unshaken faith by which many others have profited since. This man really believes in electricity and really believes that the central-station business is organized for public service as well as for private profit; he has been in the forefront of electrical advancement and is, moreover, a conspicuous exponent of the "square deal" in the electrical business. It is a pleasure to set down here the name of this man, which is Samuel Insull.

VOLTAGE REGULATION OF STATIONARY TRANSFORMERS.

An interesting discussion of the voltage regulation of a stationary transformer as affected by the exciting current is given in an article by Mr. E. H. Acton, appearing in this issue. The author has selected for his presentation the graphical method, which allows the effect of the exciting current to be shown in a striking manner. For the purpose in view the method is excellent, but one should not lose sight of the fact that the actual numerical values of the quantities are seldom shown on a vector diagram of relations in a stationary transformer. Although the effect of the presence of the exciting current is to improve the voltage regulation of a transformer, the improvement is negligible in a large proportion of the cases, by reason of the fact that the exciting current forms only a small part of the full-load current, and it is upon the latter current that the regulation is based. However, when the core is operated at a magnetic density much beyond that corresponding to maximum permeability, the exciting current assumes a value quite appreciable in comparison with the full-load current. Such a density is found in all low-frequency transformers and in the newer high-frequency transformers, the cores of which are built of silicon steel.

As pointed out by the author, the exciting current may improve the regulation to a measurable extent when the core is operated at a flux density beyond the "knee of the saturation curve." Under this condition a small increase in the flux density requires a large increase in the exciting current, so that the change in the internal voltage of the transformer when the load current is decreased from its full value to zero results in a much greater percentage increase in the exciting current. Thus, the rise in the secondary terminal voltage from full-load to no-load is somewhat less when the core is saturated than when it is unsaturated, even assuming equal percentages of no-load exciting currents in the two cores. These facts are well shown in the article. The physical significance of the relations there illustrated, and the numerical values of the quantities discussed, can best be appreciated by referring to the well-known "equivalent circuits," for representing the relations in a one-to-one ratio transformer, in which the exciting circuit is shunted across between the primary and secondary impedances.

EXPERIMENTS ON THE POULSEN ARC.

The arc of the rapidly pulsating character experimented on by Duddell, Poulsen and others is now a recognized device for obtaining sustained oscillations in the sending aerial of a wireless signaling station. It depends, as is well known, on the fact that the conductance and cross-sectional area of an arc increases with the current flowing through the same. If the current suddenly increases, the arc as suddenly swells and lowers its resistance. Such an arc, in shunt to an oscillatory combination of inductance and capacity, alternately swells and contracts at the frequency of the oscillatory branch, and automatically enhances the vigor of the oscillatory charges and discharges in the same. Such an arc may be throbbing steadily at a very high frequency and yet give no sign to the eye or ear that it is singing. Some experiments by Mr. William E. Story, Jr., on a Poulsen arc using an artificial antenna, are described in a recent number of the *Physical Review*, which is abstracted in the Digest. The frequency of oscillation set up in the antenna was ordinarily about 400,000 cycles per second. This was measured by means of a rotating-mirror photograph of the oscillating arc. The observed frequency was then compared with that computed from the measured constants of the oscillatory circuit. A very fair agreement is presented in the tabulated results.

The results go to show, first, that the current in the oscillatory arc is essentially a simple harmonic, or sinusoidal, current; and, secondly, that the numerical theory of the forced frequency is well founded. The practical utility of sustained forced oscillations in wireless telegraphy is found not merely in the economy of power which results from the use of that method, but also from the telephonic inaudibility of the stream of radiated waves. In order to produce signals the rhythm of these waves has to be broken by hand, according to the proper sequence of dots and dashes. In wireless telephony such a system of sustained forced oscillations is still more important, because the free oscillations of spark discharges, as in ordinary spark telegraphy, are insufficient to transmit con-

versation. By maintaining a constant amplitude of sustained oscillations, and of inaudible frequency in the sending aerial when conversation is not going on, no effect can be detected at the receiving masts within range. When, however, the sender talks before his transmitting apparatus, and the latter electrically modifies the amplitude of the outgoing oscillations, the distant receiving telephones are able to respond to these changes of amplitude, extending over a long series of waves, in such a manner as to repeat the sounds uttered before the transmitter. Any method by which sustained oscillation of the sending aerial may be obtained introduces the possibility of carrying on wireless telephony through the same general process.

ALTERNATING CURRENTS IN JOURNAL BEARINGS.

An article has recently appeared in *Elektrotechnik und Maschinebau*, as noted in this week's Digest, upon the production and prevention of currents in the journal bearings of alternating-current machines. This is a difficulty that may occasionally attain noteworthy proportions. When any ordinary dynamo-machine is symmetrically constructed and normally operated, the magnetic circuits within it are all balanced in such a way that, whether the rotor be at rest or at full speed, there is no e.m.f. in either direction along the shaft, and consequently there is no tendency to set up a current through the journal bearings. If, however, the magnetic circuits in the machine are dissymmetrical, either by reason of imperfect materials and workmanship, or by reason of structural dissymmetry of design, the magnetic fluxes in the stator, around the shaft, may be different in different segments and may pulsate rhythmically. In such cases the stator frame segments may virtually form a transformer core linked with a single secondary conducting loop; namely, the loop formed by the shaft, the journals and the frame external to the stator core.

A particular case in point is where the field frame of a large machine is divided by a horizontal plane through the axis, for convenience of dissassembling and of shipment. At the junction of the upper and lower halves of the field-frame there is a magnetic reluctance in the union, or surface contact, that is not found in other parts of the stator. These magnetic joints may offer sufficient reluctance to cause the flux to divide dissymmetrically and to pulsate, as the poles rotate around and within the frame. In the case of a direct-current machine, there will be no opportunity for the production of pulsating magnetic flux, or of secondary currents through the bearings, so long as the machine is at rest. But in the case of an asynchronous polyphase motor, with its rotating magnetic field, these parasitic currents may be established, whether the machine be at rest or in motion. In the case of any machine at rest, the shaft presses down gravitationally upon the bearings and makes good electric contact therewith, so that the resistance of the closed path through shaft bearings and outside frame is then very low. Particularly is this true of large machines with their extensive bearing surfaces and ample thicknesses of metal in all their parts. On the other hand, it is known that when a shaft is running freely, in well-lubricated bearings, a thin film of oil is automatically injected between the shaft and bearing surfaces, so that the shaft no longer touches the bearings metallically, but runs on oil. Such a running shaft is often well-insulated electrically from the framework of its bearings, except for the metallic oil rings, which tend to maintain electric connection at all times between them. Moreover, if the bearing is rough, or binds even in a small degree, the insulating film of oil that tends to form during rotation is broken and good electric connection will then be maintained between shaft and bearings at all speeds. Nevertheless, the electric resistance of the contact between shaft and bearings, tends to be considerably higher during rotation than when at rest.

The above considerations are illustrated in the experiments described in the article here referred to. In certain induction motors it was found that the shaft and bearing surfaces in the journals were roughened and pitted by a kind of electrolytic action due to the alternating currents induced by magnetic unbalance in the frame. When one of the bearings was insulated from the frame so as to permit of inserting a low-resistance ammeter in the circuit, a strong current was found to flow through the same. In one case, the current strength is stated to have been 200 amp. The current was always weaker, and sometimes much weaker, during the rotation of the rotor than during standstill. The objection to these parasitic currents is not so much on account of the energy they waste, because in a large machine this waste of, at most, a few hectowatts is not so dreadful, but mainly on account of the pitting and roughening of the journal surface whereby the journal friction may be materially increased and the bearings seriously injured.

A DEMONSTRATION OSCILLOGRAPH.

It is well known that if a plane mirror be subjected to small oscillations about an axis in its plane, and also to other small oscillations about a second axis in the plane perpendicular to the first, a beam of light reflected from the mirror will describe a conical path. A sheet of paper supported in the way of the cone will reveal an illuminated closed loop. In the simplest case of two harmonic oscillations with the same frequency and coincident phase, the loop will collapse into a straight line. If the two harmonic oscillations have the same frequency, but differ in phase, the loop will be an ellipse. Professor Sartori has recently described in *La Lumière Electrique* a form of double oscillograph capable of displaying vector combinations to a large audience. A small square mirror is suspended in the air midway between two single-wire oscillographs, being fastened at corners by pairs of silk threads, so that one oscillograph tends to oscillate the mirror about one axis, and the other about a perpendicular axis, both in the plane of the mirror at rest. The photographs taken of the luminous loops accompany the article, as referred to in the Digest. One of the most interesting is a pair of ellipses formed by two currents in incandescent lamp branches from three-phase, alternating-current mains. A disadvantage inherent in this type of oscillographic record is that the curves are not easily understood, except in the simplest cases, so that they have to be analyzed either algebraically or graphically; whereas, the ordinary type of oscillograph, with its rotating cylinder, produces pictures in rectangular co-ordinates that are easily understood at a glance. The Braun tube is subject to the same defect, since it also produces a picture in the form of a closed curve. But we are sometimes very glad of the possibility of using a Braun tube in measuring frequencies above the limits of wire oscillographs. Similarly, the advantage of being able to show vector relations clearly and conveniently to an audience may well outweigh the disadvantage of a closed loop picture in an oscillograph.

Charlotte A. I. E. E. Meeting.

The transportation committee of the American Institute of Electrical Engineers, of which Mr. W. L. Conwell is chairman, has made arrangements for a special train to be run from Jersey City to Charlotte, N. C., in time for the first meeting of the Institute on Wednesday, March 30. The train will leave Jersey City at 4:45 p. m. on March 29. Unless 100 persons apply in advance for transportation to Charlotte at this time, the special train will not be run and the passengers will be carried on the regular Pennsylvania-Southern train operated on the same schedule. In either event the train will arrive in Charlotte one hour before the beginning of the first meeting.

Alternating Current Motors for Hoisting Service.

At the march meeting of the American Institute of Electrical Engineers, St. Louis Section, held Wednesday evening, March 5, in the rooms of the Engineers' Club, 3817 Olive Street, St. Louis, Mr. Oddgeir Stephenson, of the Wagner Electric Manufacturing Company presented a paper on "Alternating-Current Motors for Elevator, Crane and Hoist Service." Lantern slides were exhibited showing characteristic curves for various types of windings and illustrating how by suitable combinations of these the operating characteristics of certain direct-current motors can be obtained. Recent advances in design, said Mr. Stephenson, have been successful in greatly reducing the noise of alternating-current motors for this service and in limiting the starting current to about 150 per cent of its full-load value.

Chicago Harbor and Subways.

At the meeting of the Electric Club of Chicago, on March 9, Mr. John W. Mabbs, chief engineer of the Board of Trade, Chicago, described, with the aid of wall maps, a plan which he has evolved for the creation of a large harbor for Chicago. The principal feature of this project is a breakwater about 22 miles long which would extend parallel with the shore of the lake from Evanston, north of Chicago, to a point south of the mouth of the Calumet River. This breakwater would be at an average distance from the shore line of 1¾ miles and it would be perhaps 20 ft. wide at the top. It is proposed to build it of the rock taken out in constructing the rock sections of the Drainage Canal and now lying unused.

The more particular interest of electrical men in this project lies in the fact that it is proposed to connect the wharves, which would be erected on the inner side of the breakwater opposite the central business district of the city with the mainland by means of tunnels to be connected possibly with the proposed city subway system, these tunnels to be used for the operation of railway freight trains to be electrically operated. The elevators connecting the tunnels to the wharves at the breakwater would also be driven by electric motors. An incident feature of this proposal is the protection of the purity of the water supply of Chicago, for all intake cribs would be outside of the breakwater and so protected from direct contamination of water from the Chicago River on the rare occasions when, by reason of floods or from some other cause, the usual flow of the river toward the Drainage Canal and the Mississippi River is reversed. For this purpose the plan is to make the breakwater continuous without openings.

Speaking of the subway side of his plan, Mr. Mabbs said that the existing freight tunnels of the Illinois Tunnel Company were altogether too small for the purpose. The speaker was emphatic in saying that the proposed harbor should be owned and controlled by the public and that it would be a great misfortune if the harbor facilities were allowed to fall into private hands. The cost of the breakwater alone is estimated at about $6,000,000. There was a brief discussion in which Messrs. O. B. Duncan, J. G. Pomeroy, H. M. Cox, N. B. Parsons, F. P. Vose and J. M. Wakeman, of New York, took part.

Electric Mine Hoists.

The meeting of the American Institute of Electrical Engineers held in New York on March 11 was devoted to the general subject of electrically operated mine hoists.

In a paper by Messrs. D. B. Rushmore and K. A. Pauly were discussed the characteristics of the direct-current, shunt-wound motor and the induction motor, with special reference to their suitability for hoist service. Outlines were given of the distinctive features of the types into which mine hoists may be divided, depending upon whether the rope is wound on a reel, a cylindrical drum, conical drum, cylindro-conical drum, Whiting drums, or carried over a Koepe disk. It was explained that the choice of any particular type depends largely upon the depth of shaft, the maximum permissible hoisting speed, the location of the hoist with respect to the shaft, the number of levels which are being worked simultaneously, and whether or not the shaft conditions permit the use of a tail rope.

The hoists have usually been operated by means of inefficient and uneconomical isolated steam plants located at the shaft. By the use of electric motors there may be substituted therefor highly efficient large central generating stations.

Many systems of electric hoisting have been proposed, each with a view of meeting some peculiar condition, or eliminating some real or apparent objection in the others, but virtually all the installations are confined to four systems. The simplest system consists of a polyphase induction motor directly connected or geared to the hoist drum. The speed of the motor is controlled by a variable resistance in its rotor circuit, which, because of the magnitude of the currents, involved, is usually some form of water rheostat. In the second system the hoist is driven by a direct-current shunt-wound motor receiving energy from the alternating-current supply system through a synchronous or induction-motor-generator set. The speed of the hoist motor is controlled by varying the voltage of the generator, which is separately excited, one generator being used for each motor.

In the third system advantage is taken of the low first cost and efficiency of the flywheel as a means for storing and returning large quantities of energy for short intervals. This system is similar to the second, except for the addition of a flywheel to the induction motor-generator set and an automatic regulator for varying its speed. The fourth system is similar to the first, but there is added a converter equalizer consisting of a rotary converter connected on the alternating-current side to the supply system and on the direct-current side to a motor driving a large flywheel. The field current of the direct-current motor is controlled by a regulator actuated by the line current. When the power taken by the hoist motor drops below the average the field current of the motor is automatically reduced, and the speed of the flywheel is increased, the energy being taken from the supply system. When the hoist-motor load exceeds the average, the operation is reversed, the speed of the flywheel decreasing thereby returning energy to the system.

The efficiency of the fourth system is generally slightly lower, and the weight of the flywheel is slightly greater than for the direct-current motor and the flywheel motor-generator set. It has the advantage, however, over the third system in that the operation of the hoist motor is not dependent on the operation of a converter equalizer. Consequently, in the event of the failure of the latter, hoisting may be continued, providing, of course, that the equipment of the supply system is sufficient to take the load, which would be the case if the equalizer were used simply to reduce the bill for energy.

Either the third or the fourth system may be used where the supply system is for direct current by substituting a direct-current motor for the induction motor of the flywheel motor-generator set in the third system, and omitting the synchronous converter of the flywheel converter system in the fourth.

In comparison with the steam-engine installations the electric motor hoists are advantageous from the standpoint of economy, safety and convenience.

A paper by Mr. Wilfred Sykes contained a detailed discussion

of the force, speed, power and energy relations in the various types of hoists, and an application of these relations to electric hoisting equipments in which use is made of flywheels for energy storage. The author directed attention to certain advantageous features of electric hoists from an operating standpoint. The most important is the complete control afforded over the hoist when running, enabling the operator to work much more rapidly and with greater certainty. The ease with which the braking can be taken care of electrically makes it possible to manipulate the hoist with the greatest precision, the mechanical brakes being used only for holding the load. Under certain circumstances energy may be returned to the system by the hoist, which reduces the power consumption, but the main point is that it obviates the excessive wear on the brakes which would otherwise have to absorb this energy. Electric hoists may be fitted with devices for automatically reducing the speed and preventing over-winding, which are absolutely certain in their action, and on this account the authorities in Germany allow men to be hoisted at a speed up to 2000 ft. per minute, whereas with steam hoists the limit is fixed at 1000 ft. per minute. An electric motor is a very simple machine and requires considerably less attention than a steam engine needs, and the splendid service which it gives under the most severe conditions disposes of any question as to its reliability.

Mr. R. R. Seeber outlined certain tests made upon a hoist at Winona, Mich., where the Winona Copper Company has installed an electric hoist of the flywheel motor-generator type with Ward Leonard control. There are two generators driven by a single induction motor by means of flexible couplings. These generators supply energy to motors operating hoisting drums at separate shafts. The test showed a consumption of 1.79 kw-hours per ton of rock hoisted 600 ft. up a 70-deg. incline. The coal for this energy was about 4 lb. per kw-hour, the ratio of rock to coal being 279:1. Tests made upon steam hoists under similar conditions showed a ratio varying from 100:1 to 200:1.

Coming Electrical Shows.

Following the convention of the National Electric Light Association, it is planned to hold an electric show in the Coliseum at St. Louis, opening Saturday night, May 28, and continuing the following week until Thursday, June 2. Convention exhibitors will be asked to remain over for this week with their exhibits, while a number of electrical features of local and less technical interest will be added for the benefit of the St. Louis public. The co-operative interests engaged in this undertaking have appointed a committee in charge of the show, consisting of Mr. Hermann Spoehrer, of the Union Electric Light & Power Company; Mr. Fred. Adams, of the Frank Adams Electric Company, and Mr. W. A. Layman, of the Wagner Electric Manufacturing Company. Mr. F. W. Payne, manager of the Coliseum, will also act as manager of the St. Louis Electrical Show.

An electric show is to be held the coming fall in Denver, some time between Sept. 15 and Oct. 15. This was settled at a meeting of the Colorado Electric Club held following a club entertainment at Denver on March 7. The club had a 7 p. m. dinner at the Albany Hotel, which was followed by "A Night in Bohemia, or Omlet as It Is Written," a farce in one act by Jack T. Connors, of the Denver Gas & Electric Company. The cast of characters was made up of members of the Denver Gas & Electric minstrel troupe, and consisted of: "Omlet" (Jack T. Connors); "Ghost of a Welsh Rarebit (S. E. Sanderson); and "Oatmelia (David Evans). Time: 30 days if caught. Place: Anybody's graveyard. After this talented trio of entertainers had finished, the club had a business meeting to discuss and act upon the question of holding an electric show in Denver. It was decided to organize a company under the auspices of the club to carry out the project. Stock subscriptions were taken and $8,000 out of the proposed $10,000 capitalization was subscribed then and there. Fifty-two members subscribed. One-half of the net proceeds are to go to the Colorado Electric Club. The show is to be held at the Denver Auditorium and will last one week. The chairman of the advisory board of the club, Mr. H. L. Wolfenden, will be chairman of the executive board of the show. The advisory board of the club will be the executive board of the show, its membership consisting of representatives of all the important interests in the electrical field in Denver. The club has now 195 members, and the average attendance at its lunch meetings has been 84 in the three months since it began. Mr. C. F. Oehlmann, of the Denver Gas & Electric Company, is secretary.

All arrangements have been completed for an electrical show to be held in Minneapolis from March 26 to May 2. The show, which is planned along the lines of that of Chicago, and will be held annually, is to be in charge of the Northwestern Electric Show Association, recently incorporated, with Mr. F. G. Dustin as president; Mr. George J. Cadwell, vice-president, and Mr. C. D. Wilkinson, secretary. All officers and members of the association are connected with the various local electrical industries and local sales offices of manufacturing companies. The show will be held in the armory of the National Guard, which has sufficient floor space for 100 booths each containing 150 sq. ft., and a large ornamental structure in the center in which all switches, etc., for lighting effect will be assembled. Among the features will be a balloon directed in its movements overhead in the building by wireless.

The exact date of the Pacific Coast Electrical Exposition has not yet been fixed, but the show will be held in the month of April in the Coliseum, at Oak and Baker streets, San Francisco. There will be 130 booths on the main floor. Mr. D. G. Moses, 34 Ellis Street, is general manager.

Factory Lighting.

"Factory Lighting" was the subject discussed at the February meeting of the New England Section of the Illuminating Engineering Society, the speaker being Mr. L. B. Marks, of New York. Mr. Marks pointed out that New England as a great factory center should furnish good examples of the best illumination, yet it is often difficult to secure the best installations even among those best fitted to pay for them. The average workman is used to a drop lamp over a machine, usually within a foot or two of the spindle or working surface. Substitute for that drop lamp almost any other method of lighting and the workman is apt to complain. Mr. Marks stated that factory illumination must be considered from the dual point of view of daylight and artificial lighting, the latter being an important consideration in connection with overtime work. The basements of factories are often very poorly lighted in the daytime and artificial light is a great strain if required all the time unless under the most favorable conditions. If managers of plants really appreciated the situation they would at once be willing to spend a few scores or hundreds of dollars for the sake of a change which would save them hundreds or even thousands. In this connection much good has been accomplished by the use of prismatic glassware, such as the Luxfer prism and other types. In one mill by the substitution of these daylight prisms it was possible to do away with eight skylights on two floors, thus giving the owners 10,800 sq. ft. of additional floor area and also increasing the illumination throughout the shop. Of far greater importance is the change brought about in the ability of the workman to do good work continously. The selection of glassware is an important matter. Clear-glass windows do not directly light a room, whereas certain forms of prismatic glassware direct it in one quarter or another. By the use of prismatic glass it is possible to concentrate on the rear wall of a room as much as a hundred times the intensity of illumination that would be received at that point with clear glass.

Examples were shown of the usual drop-lamp illumination of factories, including a bare-lamp installation at a drill press, and several poorly lighted work benches. Recent work in factories equipped with poor illumination gave rise to complaints from

the workmen that the new facilities were not adequate. With an ordinary 16-cp lamp and reflector probably 30 foot-candles to 40 foot-candles are delivered at a point a couple of feet away. The direct reflection from the shining surface of the object which the operator is handling comes into his eye, and the stronger the light the worse off the worker is. Ordinarily from 1 foot-candle to 3 foot-candles would be sufficient for good reading light, and for machine work of the character in hand from 5 foot-candles to 10 foot-candles would suffice at the outside.

Mr. Marks criticised at some length the practice of providing illumination which results in a series of bright spots on a dark background. Such practice is apt to give poor results, with no ultimate economy. Where the illumination is concentrated upon the work alone the workman is almost looking constantly into a searchlight. In the shops under consideration the actual general illumination at night was only about ¼ foot-candle to 1/10 foot-candle. Comparing this installation with one in which general illumination supplemented the localized lighting, and where the latter was not restricted as in the case of drop-lamp equipment, Mr. Marks said that far better results were obtained in the latter case. The localized lighting was obtained by the direct rays from lamps hung about 6 ft. above the floor. It was hard to convince the management in the latter case that it would pay to throw out the old system and expend two or three times as much money for energy, but it was done, and with great success. Emphasis was laid upon the humanitarian aspects of poor lighting, and the speaker urged the society as a whole to be outspoken in favor of the best illumination, regardless of whose interests were hit. In the milling department of a factory 8 foot-candles sufficed for daylight illumination, while the workman complained when the illumination was appreciably reduced below 76 foot-candles at night. The difference in diffusion was important, and the general intensity at night was 0.25 foot-handle.

Discussing representative industrial installations, the speaker cited a plant in which Cooper Hewitt lamps are used, the lamps consuming 385 watts each, and each one illuminating 385 sq. ft. of floor area. The actual watts per square foot are slightly less than unity. In a wood-working shop using arc lamps with concentric diffusers the power required was 1.85 watts per square foot. In a yarn factory lighted by the inverted enclosed arc lamp 40,000 sq. ft. are illuminated by 30,000 watts, and the lighting is of the indirect type, the bulbs of the lamps being concealed from view, with plenty of reflection from the walls and ceiling. The management is delighted with the design, but the lighting is open to some criticism. An example of dye-works lighting with Moore tubes was given, the white-light tube being used, and requiring about double the power of the pink-light tube. The total area of the room was 150 sq. ft., and there are about 100 ft. of tube in it, making a power supply of about 37 watts per square foot of floor area. For such work, where economy of illumination has no consideration, the Moore tube gives remarkable results for color matching. An installation of flaming-arc lamps for foundry service was shown. The advantage here was the ability of the rays to penetrate the smoke. In the case cited the actual power required was only about 1/7 watt per square foot, compared with 1 watt or 2 watts in the average factory installation. In a silk mill tungsten lamps are successfully used by being hung from the ceiling on portable duplex wires, thus taking up any vibration and minimizing breakage. The loss of lamps is extremely small. One lamp is located in front of the loom and two are set between the two looms at the rear, the distance from the bottom of the shade to the floor being about 6 ft.

With a localized system of lighting it is necessary to adjust the ideal position of the lamp in order to see the fine threads in loom work, especially when the latter are broken. In one plant where a good installation was made with 5 foot-candles or 6 foot-candles intensity the weavers are able to see distinctly broken threads, whereas the superintendent was of the opinion that it was necessary to have at least the same intensity as was used in the old mills.

In the discussion emphasis was laid upon the importance of selecting a first-class quality of glassware in buying prismatic glass. Failures are often due to dirt, which must be handled as in any equipment. It is as necessary to clean windows and shades as polished brass railings. In some cases this may be once a month or a week, and in some gritty parts of foundries perhaps daily. There is a broad economy in a first-class installation even in cases where the production is carried forward on the piece-work basis and where, consequently, the manager does not get the benefit of a larger output at a fixed price. It is a good plan to allow, roughly, three-fourths of the light in a downward direction and the rest upward, if it can be properly utilized. With shades 6 ft. to 7½ ft. above the floor a remarkably even distribution results, compared with the old practice of running a drop lamp down close to the machine. In much machine work it is necessary to use localized lamps, especially in the operation of punches and other powerful equipment where accurate and heavy work has to be done. The difficulty is usually that the local lamp is unscreened, and when one attempts to advise a change the operator makes trouble. The opinion was advanced that the ordinary factory throws away hundreds of dollars' worth of efficiency every year by its failure to use whitewash all through the shop. On account of its brittleness prismatic glassware is not as yet used to any great degree in factory lighting.

Low-Tension Distribution in Chicago.

Mr. D. W. Roper, assistant to the chief operating engineer, Commonwealth Edison Company, Chicago, who has charge of low-tension underground distribution for that company, has called our attention to an inaccuracy in our report of his discussion of the paper by Mr. E. N. Lake in our issue of March 3, entitled "Underground Conduit Construction." Although Mr. Roper does not consider the error sufficient to warrant a correction, his explanation of the conditions under which the three-wire, low-tension underground distribution in the central part of Chicago is operated is of sufficient interest to justify its publication.

Our report stated that a certain burn-out referred to on the low-tension underground system did not open the circuit-breakers until after about 30 minutes. As a matter of fact, the circuit was opened by hand and not by any automatic circuit-breaker. The Commonwealth Edison Company has no circuit-breakers on either end of its low-tension feeders. There are copper links on the station ends of these feeders which are of a size which absolutely prevents them from opening automatically. In the junction boxes in the manholes are copper fuses which are intended to open the circuits in case of a short-circuit on the feeder. These fuses are, however, so heavy that they will not open in the case of a short-circuit like the one described unless the low-tension distributing system at the point where they connect has sufficient feeder and main capacity to maintain the pressure at that point even in the case of a short-circuit on the feeder. This condition did not exist on the feeder in question, as it connected with the underground mains in a district on the West Side where most of the load is a day load only. In order to keep the voltage on the system from rising too high during the evening, it is customary to open this feeder switch as well as several others in the same territory each evening as soon as the day load is off of that part of the system.

At the time of the trouble referred to, the feeder which burned out, and to which Mr. Roper referred in his remarks, was open at the station end, and was connected to the underground distributing main at a point probably one-fourth of a mile or more distant from the nearest feeder in service. The short-circuit occurred on the feeder which was idle and the current flowing through it, therefore, came by way of the other feeders and mains. This condition, while reducing to some extent the severity of the arc, probably made the damage more serious than would otherwise have been the case, as the company's experience indicates that feeders will burn clear

when supplied with full voltage much quicker than they will where the resistance in circuit is sufficient to materially reduce the current which can flow in the short circuit.

In a case of this kind, if the feeder switches in the station are closed, the switches on the short-circuited feeder can be opened and the flow of current through the junction box fuses may perhaps cut off the current flowing to the feeder at its far end. However, the company finds that in nearly all cases the fuses in the manholes will not blow under such conditions and have to be removed by hand. This was the condition on the night in question. There were several feeders which were in trouble, and the trouble man, in opening the circuit in the manholes, could not tell which of the several to be opened were most important; probably by chance he opened one or more other feeders before opening the circuit of the one in question. The time elapsed before the opening of this feeder circuit was therefore due to the conditions just recited.

Annual Meeting of the Engineering Society of Wisconsin.

The Engineering Society of Wisconsin held its second annual meeting in Milwaukee on Feb. 23, 24 and 25. The presidential address was delivered by Prof. F. E. Turneaure, who discussed the purpose of the society and its relation to the position and dignity of the engineering profession in general.

Mr. N. P. Curtis, in a paper on "Depreciation Features of Valuation Work," pointed to a particular field of engineering labor, namely, the valuation or appraisal of public utilities, which although not new has grown up very rapidly in recent years. He dealt only with the physical value and called attention to some of the conditions which confront the engineer in a determination of such values.

The author advocated the use of the sinking-fund method by which there is set aside each year a certain sum, which, with compound interest, will yield a fund sufficient to replace the article at the end of its assumed life. The value of the article at any point of time is then assumed to have depreciated an amount equal to the accumulation—principal and interest. This value would not be affected by the existence or non-existence of such a fund. The author expressed the opinion that the sinking-fund method, with the present rate of interest obtainable, does not always give results in accord with true conditions. He proposed the use for certain conditions of the sinking-fund method with a higher rate of interest than is usually obtainable in order to reduce the rate of depreciation in the first years of the useful life of an article and to increase it more rapidly toward the end. The application of this method is particularly advisable in cases where the assumed life is rather short, say, 10 or 20 years.

A paper on hydroelectric energy transmission by Mr. Max H. Collbohm dealt with the various factors influencing the design and arrangement of machines and apparatus for the generation, control and transmission of hydroelectric energy.

Beginning at the generators the author stated that their size and number are determined by compromising between opposing requirements. Convenience of operation and first cost of total station equipment tend to reduce the number of units; on the other hand, the number of individual transmission lines requiring independent voltage regulation, or a possible low head of the development with the inconvenience of a large number of runners on a rather long common turbine shaft would call for a greater number of smaller units. The frequency to be chosen depends on whether the bulk of the energy is sold for railway or general lighting and motor service; a frequency of 25 cycles is required in the first case and 60 cycles in the latter. The lower frequency has an advantage on account of better transmission line regulation; it also causes a smaller charging current on the lines, which is of particular importance if the wave-form of the generator e.m.f. contains higher harmonics of appreciable amplitude. The author cited a case in his experience where a 25-cycle generator contained the seventeenth harmonic with an amplitude of about 5 per cent of the fundamental which besides producing a high charging current would cause destructive resonance in connection with a line about 106 miles in length. He advocated including this point in the specifications for generators. The generators should be Y-connected to avoid short-circuit currents in the generator itself, which may be set up with delta connection due to a third harmonic in the e.m.f. wave, which is usually present.

In discussing the various types of oil-switches, particularly those for high potentials, the author remarked that the construction using the horizontal break should be more effective than the one with the vertical break, owing to the tendency of the arc to rise vertically. The vertical-break type requires very large vertical dimensions to interrupt the arc safely on its downward motion and to avoid explosive action near the oil level. This type of switch is therefore rather large and expensive, particularly at higher voltage, as compared with the horizontal-break type with a minimum of actuating members.

Very large stations have occasionally been equipped with electro-pneumatic oil switches built in single-phase units. This switch type requires the installation of a duplicate compressor set with main and secondary air tanks and considerable piping. It has the other disadvantage that on account of lack of actuating members having ground potential, a reliable indicating device showing at the control switchboard the position of the oil switch cannot be installed very conveniently. On account of the single-pole construction there is less assurance that all three-phase leads will be opened simultaneously.

After dealing with equipments for protection to station apparatus, such as arresters, particularly of the aluminum type, and choke coils, the author discussed the essential features of the transmission line. He pointed out the advantage of copper conductors over aluminum, due to their greater strength and smaller coefficient of expansion and their low rate of depreciation on account of the high scrap value for copper.

He advocated the use of copper cables with a hemp center to allow all of the individual wires around the center to be stressed alike, thereby using the full strength of the cable; as against a solid core construction where the center wire may be overstressed while the outer wires are under less tension.

He stated that it has been proposed to install auxiliary steam plants in connection with transmission lines and to keep them ready for service all of the time in order to supply energy at times of interruption over the lines. He expressed the belief that the money required for such plants may be more profitably spent for improvments on the transmission line, which may best be done by running each circuit on a separate right-of-way and by providing more guard wires of copper-clad steel over the line wires and grounding them at every tower.

Mr. C. V. Seastone pointed out various methods in use for anchoring steel towers. He called particular attention to the method used for the High Falls-Green Bay high-tension transmission line of the Northern Hydroelectric Power Company. For this construction the steel anchor posts or bases of the tower were imbedded in concrete pedestals molded at Green Bay and transported to the various tower sites and afterward set and tamped in the earth. The pedestals for standard towers were made 6 in. in diameter at the top, 20 in. at the bottom and set 5 ft. deep. Mr. Seastone stated that this method is more economical and the results secured are more satisfactory than when concrete is mixed in the field, and deposited in the earth around the steel anchorage angle. He also stated that the securing of the right-of-way is to an extent simplified by not mixing concrete on the premises of the property owner. The cost of a standard 40-ft. foundation on tangent, constructed by the pedestal method as above outlined, including labor and material for four pedestals, transportation to place, digging of holes and setting, is about $10.

Mr. W. R. McGovern in a paper entitled "Protection of Telephone and Telegraph Lines Against High-Potential Circuits" dealt with the mechanical requirements for preventing low-potential circuits from getting into physical contact with high-potential lines at points of crossing or paralleling at close dis-

tance. The high-potential conductors should be designed for the maximum stress conditions for which the author assumes a maximum ice coating 0.5 in. in thickness, a minimum temperature of zero deg. Fahr., and a wind velocity of 70 miles per hour. The poles or towers for high-potential circuits should have the following factors of safety: Steel, 3; reinforced concrete, 4; completely creosoted wood, 5; other wood, 6.

In discussing Mr. McGovern's paper Mr. M. H. Collbohm pointed out that the lowest temperature should be taken at about 30 deg. Fahr. below zero instead of zero, but that the wind velocity value may be reduced to 40 miles per hour. Sleet conditions recently experienced in Wisconsin showed a maximum diameter of frozen snow coating weighing 0.5 lb. per lineal foot. He cited a case in his knowledge where a live 33,000-volt aluminum line broke down under such load. He remarked that besides guarding a telephone or telegraph circuit against physical contact it must also be protected against electrostatic and electromagnetic disturbances and leakage, particularly when paralleling single-phase lines with ground return.

The report of the committee on electrical engineering was submitted by Prof. J. W. Shuster. The report covers telephony, central stations, industrial electric service, hydroelectric developments and electric railways. In the central-station industry Wisconsin was a pioneer with its first lighting plant at Appleton, installed about 1882. The present record shows 215 towns with electric lighting plants having a total generating equipment rating of about 65,600 kw. The available water-power in Wisconsin is estimated at 1,000,000 hp, of which about 200,000 hp have been developed.

The electric railways in the State cover about 600 miles of track; there are 26 operating companies, with an equipment of 1281 passenger cars, 132 other revenue cars, 334 utility equipment cars and 3 electric locomotives.

Ohio Telephone Merger Bill.

The Elson telephone merger bill was passed by a bare majority vote in the Ohio House of Representatives last week, after an amendment had been made to it that somewhat modified the favorable terms under which companies might be merged. The original bill provided for the connection of lines of intersecting or parallel systems, with the provision that they shall be merged thereafter under terms to be agreed upon by the boards of directors or arbitrators chosen in the usual way.

When the bill came before the House it was apparent that it could not be passed in the original form. Representative L. K. Langdon offered an amendment providing that no merger shall be effected until approved by the State Railroad Commission, which shall be authorized to regulate tolls and require adequate service. Representatives of the companies who had been in Columbus working for the passage of the bill opposed this amendment, but when it became apparent that it could not succeed without it, they consented to it. The amendment was adopted. Representative Elson, author of the bill, also offered an amendment making the consent of the railroad commission necessary before a merger could be effected, but opposed giving that body any authority over the rates or service. An amendment, proposed by Representative Wood, requiring that the consent of the railroad commission to issue stocks and bonds be secured, was defeated, as was the motion of Representative Winter that it be placed at the foot of the calendar. The fight is only half over, however, as the Senate must now be reckoned with.

Representative Elson has already introduced a public-utilities bill which, he claims, will cover all the points of objection raised against the telephone bill. It provides for investigations of the conduct of telephone companies by the State Railroad Commission, the same as other utilities; gives the commission the right to make recommendations and issue orders to the companies under its control and do other things that will tend to keep them in check. Nothing is said in this bill regarding rates and tolls, but Mr. Elson has promised to amend it in this respect. The weakness of the measure is seen, however, in the fact that no penalties are attached for disobedience to laws and rules.

An attempt to reconsider the Elson bill the day after it was passed by the House failed. It is said that a plan had been formulated to get the bill before the House again and then amend it so that it would apply only to local exchanges. It was believed that this would take away the most objectionable feature, that of allowing the long-distance lines to be consolidated.

Ohio Public Utilities News.

The Woods public-utilities bill, providing for a commission to have charge of all utilities, was made a special order by the Ohio Legislature for March 16, notwithstanding the fact that it was thought to be practically dead a week ago. Interest has also been revived in the Langdon tax commission bill, which carries with it an extension of the Nichols law to all utility corporations. As this bill is based upon the Cole excise tax law, and this has been declared unconstitutional in some States, Representative Langdon has been charged with formulating amendments that will make it come within the bounds of constitutionality before his own bill is taken up. He will also revamp the Willis corporation tax law, it is said, and raise the rate from one-tenth of 1 per cent to one-fifth of 1 per cent on the capital stock issued by corporations.

Legislation Against Baltimore Central Station.

Last week several bills passed the Maryland House of Delegates which repeal the laws which granted the Consolidated Gas, Electric Light & Power Company a monopoly in the city of Baltimore, and are now before the Senate. The bills will be looked after by the president of the Senate, Mr. Gorman, who is now one of the principal anti-monopolists in Annapolis.

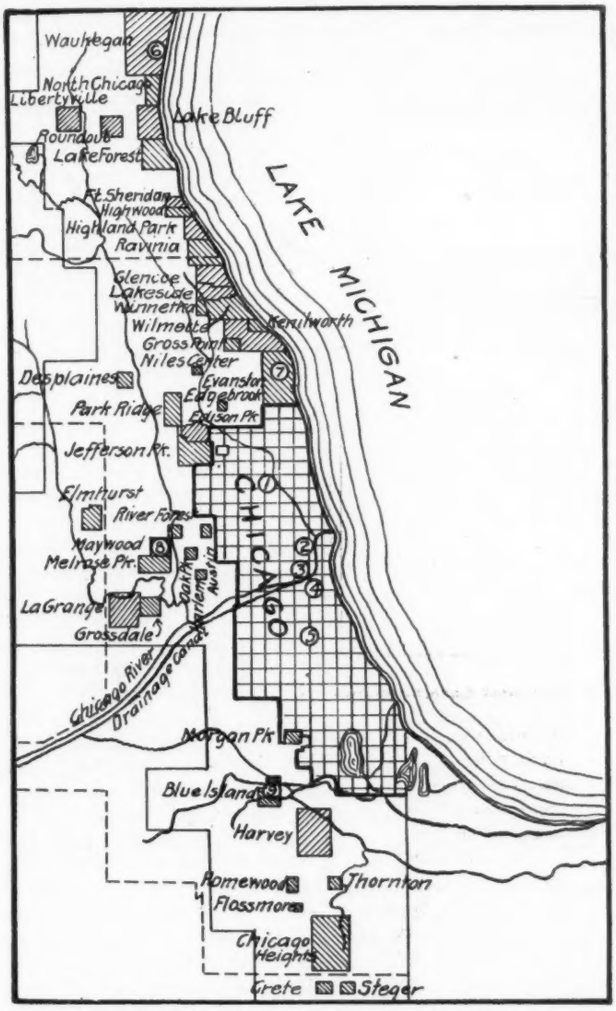
Attorney-General Straus says he has no doubt that the Baltimore Light, Heat & Refrigerating Company will have the right to sell electrical energy in Baltimore city without the necessity of securing additional franchise rights from the city if the bill repealing the electric light monopoly clause in existing law is passed by the Senate and signed by the Governor. Under the general incorporation law corporations may be formed for the purpose of engaging in the electric light business. Such a corporation, he says, could properly and legally acquire such a franchise as was granted to a company in 1904. The corporation law passed by the last Legislature had in it a section limiting the law with respect to electric light companies, and with the repeal of that provision the way will be open for this competing company to begin the furnishing of electricity in Baltimore without delay.

The fact that the repeal of the monopoly provision means competition was a new idea to members of the Legislature when they read the article in the daily papers of Baltimore last week detailing the facts concerning the scope of the recent ordinance. Some of the lawyers in the body were disposed to believe that the Baltimore Light, Heat & Refrigerating Company would have to get a new charter from the Legislature anyhow. They claimed that a corporation had to be expressly authorized to do the business before it could utilize the franchise granted to an individual. Others agreed with the Attorney-General that the general incorporation law was all-sufficient. The refrigerating company is now before the Legislature asking for a new charter, but an amendment will be offered to the bill which has been introduced expressly prohibiting the new company from utilizing the electric feature of the Fentress-Medairy franchise until the city authorities of Baltimore have again passed on the question.

The Fentress-Medairy franchise was in the form of an ordinance, signed by one of the former Mayors of Baltimore in December, 1904, which gives to Messrs. Fentress and Medairy the right to furnish electrical energy throughout Baltimore, using the subways in the subway district and erecting poles and wires outside of that district.

Commonwealth Edison Company to Build Two New 120,000-KW Generating Stations with 20,000-KW Units.

The enterprise, progessiveness and boldness of the Commonwealth Edison Company of Chicago is again illustrated by the announcement below of its latest plans. While work is still in progress on the second portion of the new Quarry Street generating station of this company, which will have six 14,000-kw turbo-generators when completed, three of which have been in operation for some time, announcement is made that two entirely new generating stations, to have a rating of 120,000 kw each, are to be built in a new locality on the North Branch of the Chicago River near Roscoe Street and California Avenue



1.—*Site of New Northwest Station.* 2.—*Harrison Street Station.* 3.—*Fisk Street Station.* 4.—*Quarry Street Station.* 5.—*Fifty-sixth Street Station.* 6.—*Waukegan Station.* 7.—*Evanston Station.* 8.—*Maywood Station.* 9.—*Blue Island Station.*

Fig. 1—Map Showing Generating Stations in and near Chicago. Stations Nos. 1 to 5 inclusive belong to Commonwealth Edison Co. Stations Nos. 6 to 9 inclusive belong to North Shore Electric Co.

extended. The accompanying map, Fig. 1, shows the relative location of this new generating station site. This map also shows the other generating stations of the Commonwealth Edison Company and the generating stations of the North Shore Electric Company for the surrounding territory, although a large portion of the territory served by the North Shore Electric Company is not shown on the map. Fig. 2 shows the site of the land which has been recently purchased on the North Branch of the Chicago River for the new Northwest power stations. The shaded area, as shown on this diagram, is not included in the Commonwealth site.

The present generating capacity of the Commonwealth Edison Company, including that portion of the Quarry Street station now under construction, is about 240,000 kw, divided as follows: Fisk Street, 120,000 kw; Quarry Street, 84,000 kw; miscellaneous plants and storage batteries, 36,000 kw. It is proposed to erect on the new California Avenue site ultimately two duplicate power generating stations of 120,000 kw each. This addition will thus double the generating capacity of the company, making it 480,000 kw, and the planning of this great extension shows not only the remarkable growth of the business, but the manner in which the administration of this company, under the exceptionally able leadership of Mr. Samuel Insull, is preparing for the future. Mr. Insull, it may be added, is also president of the North Shore Electric Company.

It is planned to have two 120,000-kw stations, as stated, but only one of these will be started at present. Work will be begun, however, on this station within a few weeks. The salient feature of this power house will be an equipment of turbo-generator units of 20,000-kw rating. There will be six of these in each of the power houses, and the initial installation for the first station will be two units. These machines will be by far the largest electrical generating units ever built. In the installation of these great generating units, the Commonwealth Edison Company, under the direction of Mr. Insull, is simply true to its record of being the pioneer in central-station design. When the Fisk Street station was designed about eight years ago, the company demanded from the manufacturers the largest electrical generating units made up to that time. These, which were also the first large power-house steam turbines, were 5000-kw machines. Later, with the rapid progress of the art, the Fisk Street station was rearranged, and again the company demanded machines of a greater rating than any previously existing, installing 12,000-kw units. When Quarry Street was designed the company made another step in advance, requiring 14,000-kw units. Now plans are well under way for a new generating station, and orders have been closed with the manufacturer—the General Electric Company in each case—for turbo-generators which will have a rating of 20,000 kw, much higher than any other machines now in service. This rating is for continuous service.

The growth of the business of the Commonwealth Company warrants these remarkable extensions, for the maximum load of the winter of 1909-10 was 40 per cent greater than the corresponding maximum the year before. It is believed that

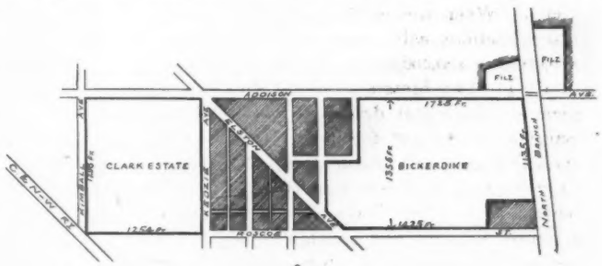


Fig. 2—Map of Sites for Commonwealth Edison Company's New Plant.

the output of the company for the present calendar year will be between 500,000,000 and 600,000,000 kw-hours. This is probably a larger output of electricity than that of any other single organization in the world and is greater than that of the largest of the Niagara Falls power companies.

The land purchased for the new power house site, as shown in Fig. 2, lies mainly between Addison Avenue on the north and Roscoe Street on the south, extending from the North Branch of the Chicago River on the east to Kimball Avenue on the west. This location is about six miles in a direct line northwest of the center of the "downtown" business district of Chicago. This part of Chicago is not thickly settled and the land was purchased in acre lots, there being 107 acres in all bought from various owners for $351,000. The acquirement of this land has been going on quietly for some time.

The power houses will be located in that portion of the site

marked "Bickerdike," from the name of the late owners. They will be near the river from which condensing water will be obtained, but some distance back from the shore line. That portion of the site on the west marked "Clark Estate" will be used for railroad switching yards and general purposes. It is connected with the land to the east by a right-of-way 50 ft. wide running from Kedzie Avenue to Elston Avenue, as shown in Fig. 2. The railroad tracks from the Chicago & Northwestern Railway will be laid on this right-of-way, and the principal supply of coal will be brought in over these tracks, although coal can also be procured from barges on the river if needed.

While work will be begun on the first of the two plants very soon, it will probably be several years before the two are completed. When the work is accomplished, the outlay on these power stations will represent an expenditure of between $15,000,000 and $20,000,000. The buildings for the new stations will be designed by Messrs. Holabird & Roche, architects, while the general mechanical design is in the hands of Mr. Frederick Sargent, of Sargent & Lundy, consulting engineers. The electrical equipment is planned by the engineering staff of the Commonwealth Edison Company. It is interesting to note, parenthetically, that persons are still living who recall the shooting of wild deer on this land, part of which is now to be the site of perhaps the largest electrical central-station enterprise ever undertaken in this country.

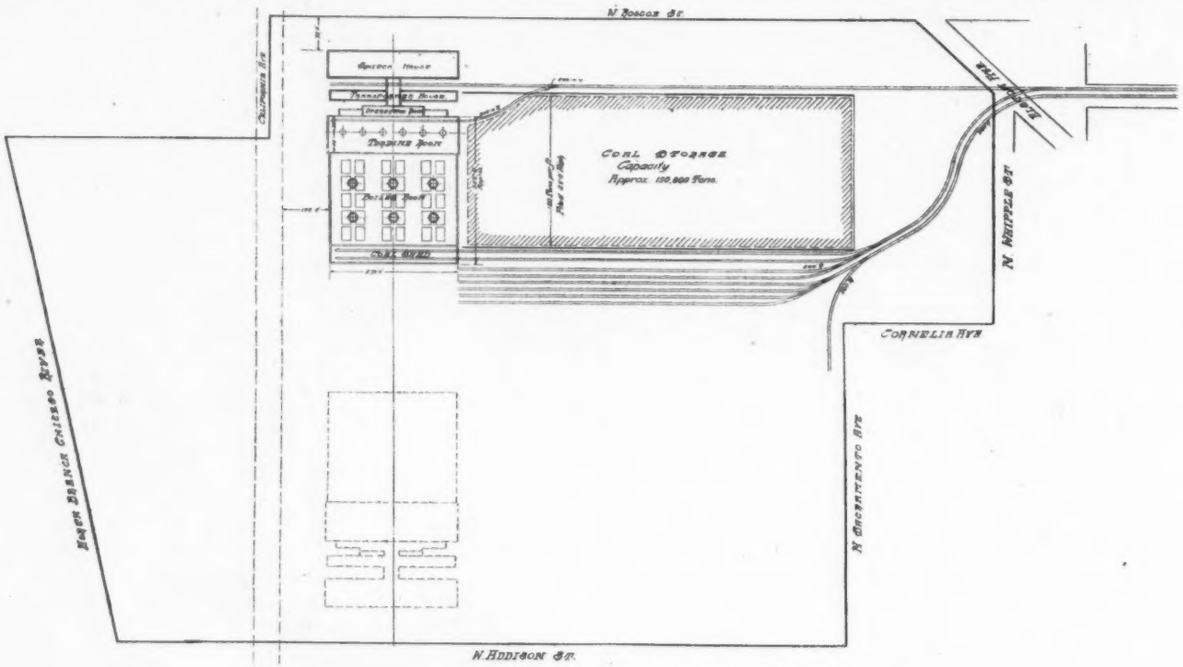


Fig. 3—General Layout Plan of New Northwest Generating Stations.

Fig. 3 is a general layout plan of the new Northwest generating stations, as prepared by Mr. Sargent. The general arrangement provides for a coal shed at the north, a boiler-room adjoining it, and a turbine-room with an operating switch-house addition at the south, these three divisions forming the main power house. The dimensions of this power house, when completed, will be 325 ft. frontage on California Avenue when extended through the property, with a depth of 276 ft. Two auxiliary buildings will supplement the main power station on the south, as shown in the drawing. These are a transformer house and the main switch-house, the latter containing the oil switches and switching gear. The main switch-house will be three stories high and it will be connected at the third story by a covered bridge extending through the transformer house to the level of the operating gallery of the control switch-house in the main power station. The general engineering layout very much resembles that at Fisk Street. The unit plan will be used, the boiler lanes extending at right angles to the turbine-room. A unit will consist of one 20,000-kw turbo-generator, 10 boilers, and one chimney and the necessary auxiliaries. There will be six chimneys 17 ft. in inside diameter and extending 250 ft. above the boiler-room floor. There will thus be one chimney for every 10 boilers.

In the rear of the station and to the west of it outdoor storage is provided for approximately 150,000 tons of coal. This, it is figured will be 60 days' supply for a complete station running to its full capacity. A gantry traveling crane will span this coal pile. Railroad tracks will extend not only throughout the length of the power-house coal shed but also directly through one side of the turbine-room and between the transformer house and the main switch house. A concrete tunnel about 700 ft. long will connect each power house to the river and condensing water will be obtained through this tunnel.

Each power house is planned to have six 20,000-kw turbo-generators at continuous rating. These will be vertical machines consisting of Curtis steam turbines and General Electric alternators, and will not differ greatly in appearance from the 14,000-kw units at the Quarry Street station. The generators will be 2300-volt, 25-cycle, three-phase, 750-r.p.m. machines. The dynamo potential will be raised in the transformer house to 9000 volts, 12,000 volts or 20,000 volts, as required. The interiors of both the boiler-rooms and engine-rooms will be lined with white enameled brick. The exteriors of the buildings will be simple, but dignified and handsome, with some ornamentation appropriate to their massive appearance. The red-brick construction, which has become standard for Commonwealth Edison power houses and substations, will be used in these new buildings. Between the two power stations it is planned to erect an administration building containing offices, a dining-room and kitchen, and also several sleeping-rooms to be used by the engineers or officers of the company in case of emergency service at stations.

In the turbine-room the units will be placed in a row and will be spaced 44 ft. between centers. This is only 3 ft. more than the corresponding distance in the Fisk Street station, with 12,000-kw units compared to the 20,000-kw machines in the station under description. It is also noteworthy that the turbine-room in the Northwest plant will be but 70 ft. wide, which is only 5 ft. greater than at Fisk Street. A rating of 120,000 kw is placed in the length of 276 ft.

It is extremely instructive to note the marked economy in boiler-room and engine-room area, particularly the latter, which

is obtained by the 20,000-kw units of Northwest station compared with the 12,000-kw units of Fisk Street station. The comparison may be tabulated as follows:

COMPARATIVE BOILER-ROOM AND ENGINE-ROOM AREAS PER UNIT.

	12,000-kw Unit (Fisk St. Station), sq. ft.	20,000-kw Unit (Northwest Station), sq. ft.
Boiler-room area (per unit)	5,740	8,800
Engine-room area (per unit)	2,665	3,080
Total for both (per unit)	8,405	11,880
Boiler-room area (per kilowatt of rating)	0.478	0.440
Engine-room area (per kilowatt of rating)	0.222	0.154
Total for both (per kilowatt of rating)	0.700	0.594

These figures, it is to be remarked, include all auxiliaries which are placed on the engine-room floor in each case. The net result is that at Fisk Street, with 12,000-kw units, a kilowatt of output is produced on 0.700 sq. ft. of area, while in the new Northwest station, with 20,000-kw units, a kilowatt of output will be produced on 0.594 sq. ft. of area. Naturally, the net saving of floor space is much more marked in the engine-room, where it is 30 per cent, but the net saving in the boiler-room and engine-room combined works out to the satisfactory figure of 15 per cent.

The 20,000-kw units stand 28 ft. above the floor line and are 15 ft. in diameter. The whole height of the unit above its condenser is 35 ft. 7 in. The condenser for each turbine is placed under it and extends out on either side. Each of these 20,000-kw units will take 260,000 lb. of steam an hour, or 130 hour-tons of steam, if the conception may be expressed that way. One particularly interesting feature of the new plant will be that it is designed for a maximum boiler pressure of 250 lb. to the square inch. Heretofore the maximum pressure in stationary power-house practice has been from 200 lb. to 225 lb.

As stated, the turbo-generators have been already ordered and work will be commenced very soon on the construction of the first of the new Northwest power stations. The initial installation will consist of two generating units and about one-third of the ultimate boiler capacity, with two stacks. However, in the turbine-room something more than half of the entire structure will be completed so as to take in the whole operating switch house, which is placed midway of the turbine-room in its longest dimension and at one side of it, as shown in Fig. 3.

Proposed Saltillo, Mexico, Hydroelectric Plant.

Another great electric power enterprise for northern Mexico is said to be assured. Mr. Frank A. Liliendahl, of Saltillo, who is well known in financial and business circles of Mexico and the United States through his successful promotion of the Coahuila & Pacific Railroad, that is now a part of the National Railways of Mexico, has been working on this electric power project for the last three years. It is announced that he now has the financial arangements closed, having taken up the project with a syndicate of New York men who have agreed to raise the necessary funds to finance the enterprise. The Government concession which Mr. Liliendahl holds for this enterprise provides that the hydroelectric plant shall be erected on the Pilon River near Montemorelos, State of Nuevo Leon. The initial capacity of the plant will be 15,000 hp, but this will be increased to 100,000 hp as rapidly as the demand for the electrical energy increases.

The chief market for the electrical energy will be in Monterey, which is the principal manufacturing and industrial center of Mexico, having a population of about 80,000 people. Electric transmission lines will also be built to Saltillo, Victoria, Linares and a number of other small towns. It is 48 miles from the site of the proposed hydroelectric plant to Monterey. The surveys for the plant have been made and construction will soon be started, it is announced.

Electric Generating Installation for the Panama Canal.

The electrical equipment of the Miraflores power house, located near the operated line of the Panama Railroad, in the Pacific Division, was placed in service on Feb. 1, 1910. The equipment is housed in a building 157.5 ft. long by 76.5 ft. wide. The main room is 39 ft. in height, and there is a 14-ft. basement.

The generating equipment consists of three 1500-kw, 2200-volt, three-phase, 25-cycle turbo-alternators with base condensers; two 35-kw, 125-volt turbo-exciters and one 30-kw, 125-volt induction motor-driven exciter. The turbines are of the Curtis vertical type. Their guaranteed steam consumption is

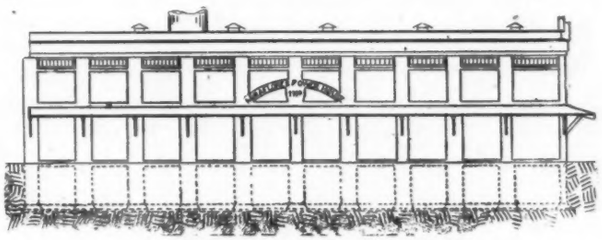


Fig. 1—Elevation of Miraflores Station.

17.6 lb. per kw-hour when operating at 100 per cent load, with 150-lb. gage pressure, 140 deg. Fahr., superheat at throttle, 2-in. absolute back pressure and 12 kw excitation at 125 volts. The condenser equipment for each turbine consists of one 3500-sq. ft. surface condenser, one engine-driven centrifugal circulating pump and one dry-vacuum pump. All steam-driven auxiliaries are designed for 150 deg. Fahr. superheat.

In addition, there will be installed for service during construction of the locks two 500-kw, 600-volt and one 300-kw, 600-volt rotary converters. These will be located in a temporary structure portion of the building. The two 500-kw converters are now located in the substation at Pedro Miguel, but these will be installed later in the generating station to furnish energy for work at Miraflores. There is also a 300-kw converter installed at Balboa to furnish energy for the sand-unloading cranes.

An idea of the arrangement of the apparatus in the power house can be gained from Fig. 2, where *A* represents the turbo-alternators; *B*, the boilers; 1, three sets of transformers, three in each; 2, three reactance coils, one to each set of transformers; 3, three rotary converters; 4, benchboard; 5, relay and meter board; 6, exciter board; 7, direct-current feeder board;

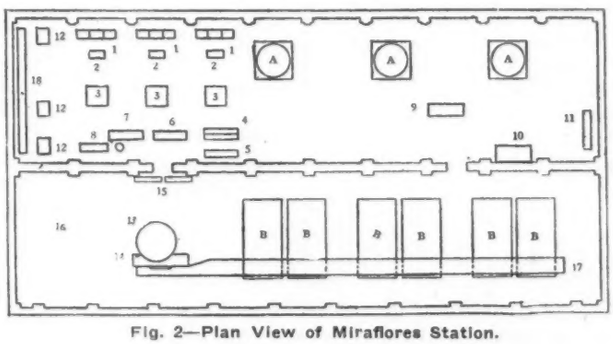


Fig. 2—Plan View of Miraflores Station.

8, air-compressor motor, induced-draft fan motor and station lighting transformers; 9, feed pumps; 10, feed-water heater; 11, motor-driven air-compressor; 12, oil switches, one for each turbo-alternator and rotary converter; 13, stack; 14, induced-draft fans; 15, oil filter and storage tanks; 16, machine shop; 17, breeching connecting the boilers to the induced-draft system; 18, feeder oil switches.

Overhead three-phase transmission lines deliver energy generated to the concrete-handling plants at Pedro Miguel and Miraflores, various electrically driven pumps, the Ancon quarry

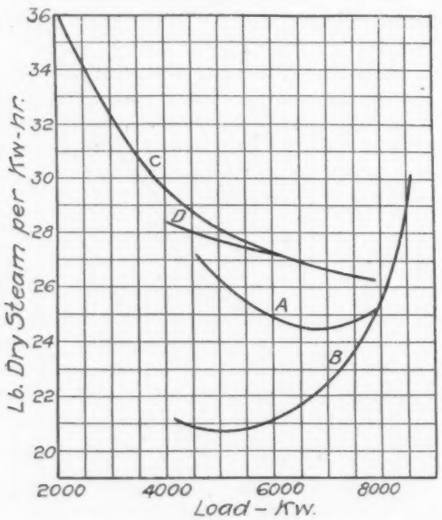
crusher plant and the sand-unloading cranes at Balboa. The lines to Ancon quarry are approximately 5.5 miles in length and the one to Balboa approximately 4 miles.

Tests of a 15,000-KW Steam-Engine-Turbine.

At a meeting of the American Society of Mechanical Engineers, with the co-operation of the American Institute of Electrical Engineers, held in New York March 8, Messrs. Henry G. Stott and R. J. S. Pigott presented a paper entitled "Tests of a 15,000-kw Steam-Engine-Turbine Unit." An illustrated description of the first 15,000-kw unit of this kind operated in the power house of the Interborough Rapid Transit Company at Eleventh Avenue and Fifty-ninth Street, New York, was described in our issue of Aug. 12, 1909. Since then two more units have been installed and the paper presented gives the results of tests on the first two units, the third unit not having been tested yet. Owing to the increased traffic on the subway it became necessary to provide additional equipment in the Fifty-ninth Street station. The authors give the reasons for installing the type of prime mover and generator chosen in preference to electric transmission from a water-power plant, a gas engine, a reciprocating engine of the same type and a high-pressure steam turbine.

The preliminary calculations, based upon the manufacturer's guarantees for the low-pressure and high-pressure turbines, showed that the combined engine-turbine unit would give at least 8 per cent better efficiency than the high-pressure unit, so that it was decided to place an order for one 7500-kw (maximum rating) unit, as by this means not only would an increase of 100 per cent in capacity be obtained, but the engines at present installed would have a new lease of life by bringing their thermal efficiency up to a point not attained by any other type of steam plant.

The turbine installed is of the vertical, three-stage impulse type, having six fixed nozzles and six which can be operated by hand, so as to control the back pressure on the engine, or the division of load between engine and turbine. An emergency

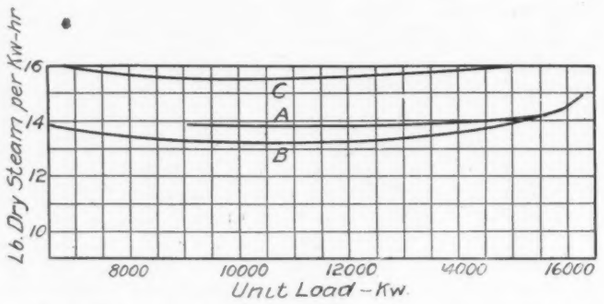


A.—Water rate of engine with constant nozzle pressure. B.—Water rate of engine with variable nozzle pressure. C.—Water rate of turbine with variable nozzle pressure. D.—Water rate of turbine with constant nozzle pressure.

Fig. 1—Variation of Water Rate with Load.

overspeed governor which trips a 40-in. butterfly valve on the steam pipe connecting the separator and the turbine, and at the same time the 8-in. vacuum breaker on the condenser, is the only form of governor used. The condensing plant is of the surface type, capable of maintaining a vacuum within 1.1 in. of the barometer when condensing 150,000 lb. of steam per hour and supplied with circulating water at a temperature of 65 deg. Fahr.

The electric generator is of the three-phase induction type, star wound for 11,000 volts, 25 cycles and a speed of approximately 750 r.p.m. The rotor is of the squirrel-cage type with bar winding connecting into common busbar straps at each end. This type of generator was chosen as being specially suited to the conditions obtaining in the plant. The absence of fields leads to the simplest possible switching apparatus, as the induction generator leads are tied in solidly through knife switches, which are never opened, to the main generator leads. The switchboard operator has no control whatever over the in-



A.—Constant nozzle pressure. B.—Variable nozzle pressure. C.—Recent guarantee for high-pressure turbine under the same plant conditions.

Fig. 2—Variation of Unit Water Rate with Load.

duction generator and only knows it is present by the increased output on the engine-generator instruments.

The method of starting is simplicity itself; the engine generator is excited before starting the engine and then the latter is brought up to speed and synchronized in the usual manner. While starting in this way, the induction generator acts as a motor until sufficient steam passes through the engine to carry the turbine above synchronous speed, when it immediately becomes a generator and picks up the load.

Instead of inserting the enormous accumulation of data incident to these tests, the paper is divided into two parts, the first part giving the reasons for adopting the particular type of apparatus and a summary of results, and the second part containing all the principal data acquired during the tests, with sufficient explanation to make their meaning clear without reference to the text. The tables and curve sheets embrace the following: Series A: Engine tests made in connection with acceptance tests, and also later to determine best conditions for operation. Series B: Calculations and data furnished by the turbine manufacturer to determine probable results when combined with engine data in Series A. Series C: Tests on the first combined unit. This unit was hurriedly put into commission in order to obtain results to determine future developments. To get the piping done, old riveted steel pipe was used which was very leaky under vacuum; the quality of steam entering the turbine was also poor. Series D: Tests of the second unit, with poor vacuum and poor quality of steam. Series E and F: Tests on the second unit, conditions of vacuum and steam entering turbines being nearly standard. In all results, except where specially noted, moisture corrections are simple corrections, 1 per cent corrections being made for each per cent of moisture. Vacuum corrections for the combined unit are 1 lb. for each inch variation from 28.5 in. when referred to 29.92 in. barometer.

The net results obtained by the installation of low-pressure turbine units are summarized as follows: An increase of 100 per cent in maximum capacity of plant; an increase of 146 per cent in economic capacity of plant; a saving of approximately 85 per cent of the condensed steam for return to the boilers; an average improvement in economy of 13 per cent over the best high-pressure turbine results; an average improvement in economy of 25 per cent (between the limits of 7000 kw and 15,000 kw) over the results obtained by the engine units alone; an average unit thermal efficiency between the limits of 6500 kw and 15,500 kw of 20.6 per cent.

Prior to the discussion on the paper Mr. Pigott explained briefly the method of conducting the tests, the types of measur-

ing instruments used, their accuracy and the precautions taken to make all the results trustworthy.

DISCUSSION.

Dr. Steinmetz, in opening the discussion, showed wherein the induction generator differed in make-up and performance from the synchronous generator, and how that the possibility of hunting could not exist with the induction generator. He pointed out that the induction generator alone cannot supply a general alternating-current load and that in a system requiring considerable lagging currents, a large percentage of induction generators is a questionable advantage. For a system like that operated by the Interborough Rapid Transit Company with numerous synchronous generators and rotary converters, the induction generator is of great advantage, giving straight conversion from mechanical to electrical power. The machine is ideal to float on an alternating-current system for receiving available mechanical power in any form.

Mr. Max Rotter requested information on the means employed for eliminating the oil from the exhaust steam coming from the reciprocating engine, and also desired to know if Mr. Stott would recommend a combined unit such as that described in preference to a high-pressure turbine of the same output. He stated that an improvement of 13 per cent seemed rather high and that 8 per cent was probably nearer the actual results. The guarantee of 15.6 lb. on large high-pressure units could probably be bettered by at least 2 lb.

Mr. Junggren pointed out that a high-pressure turbine operating under the conditions obtaining would not have adapted itself so readily to variations in load. If the same money were spent on a high-pressure unit, however, as was represented in the cost of the combined engine and turbine unit, its performance could doubtless be improved.

Mr. George R. Parker thought the reason why exhaust turbines were not more quickly adopted was because the saving indicated appeared so high as to make it almost unbelievable. If an improvement of only from 15 per cent to 20 per cent were claimed the manufacturers would be more successful in making installations. He would not advise the installation of low-pressure units in plants of less than 300 kw or 400 kw capacity, since below such outputs the actual cost of production was not so important as the fixed investment and labor charges.

Mr. Samuelson, of Rugby, England, said that abroad mixed-pressure units were coming into general use, and Mr. H. B. Carroll read a letter from Mr. W. L. R. Emmett, who pointed out that in many cases the question of first cost is not so important as the cost of producing electricity from the fuel. Mr. C. O. Mailloux regretted that the economy possible by the installation of low-pressure units with poor reciprocating engines was not brought out, because he felt that if economy was so marked with a first-class unit it would be even more so with poorer engines, especially if superheated steam were employed. He cited a case abroad where graphite was used instead of oil for cylinder lubrication, so that this would be a method of eliminating the oil from the exhaust steam of the reciprocating engine.

In summing up, Mr. Stott replied to Mr. Rotter's inquiry that the separator specifications called for not more than 0.4 grain of oil per gallon of condensation, an amount harmless for boiler-feed purposes. The question of installing a combination unit in preference to a high-pressure turbine was one of engineering and could not be answered without a thorough knowledge of operating conditions, load, etc. If the fixed charges are very high, one should not bother so much about the operating costs. For a plant with a 10 per cent peak load, he would not consider a highly expensive initial installation of any kind, particularly such machinery as gas engines. In such instances it was a fallacy to speak of low stand-by charges, as the fixed charges are more important. He agreed with Mr. Mailloux on the desirability of low-pressure turbines in connection with poor reciprocating engines. All of the tests made and recorded in his paper, Mr. Stott said, were made with machines under operating conditions with loads varying constantly 15 per cent either way.

American Bell Annual Report.

The annual report of the American Bell Telephone & Telegraph Company, just issued, is in several ways the most interesting that the company has ever put forth. A considerable part of the contents consists of an account of the history and development of the Bell telephone system from 1877 to date.

DEVELOPMENT OF BELL TELEPHONE SYSTEM.

In 1877 the first association or company to hold patents was organized, and the following year the first companies to exploit the business systematically were formed, one for New England and one for the rest of the United States and Canada. These companies succeeded to all the rights and property of the original association. The capital, $650,000, represented the patents, such rights and property as were acquired up to the spring of 1878, and in addition $100,000 in cash. Early in 1879 these two companies were consolidated to form the National Bell Telephone Company, with a capital of $850,000; $650,000 in stock was given share for share for the stock of the two old companies and $200,000 left in the treasury. The treasury stock was sold as the company required money for the best price obtainable, and the $200,000 par yielded to the treasury $430,000 in cash, an average of $215 per share, the last 500 shares having been sold for $600 each. In 1879 a settlement was made with the Western Union Telegraph Company which removed it from the field as a competitor. During this period inflated reports of prices realized for stock were current, the $100 shares being quoted at one time at $1,000; few, if any, transactions took place, however, at this price, the sale of treasury stock at $600 per share being probably the best price at which any considerable transaction took place. The stock was fairly well distributed among 338 holders, the average being about 25 shares apiece, 12 holding lots of 200 shares or over, an aggregate of 4795 out of the 8500. It is added that at the highest quotation reported the total market value of all of the shares of the company would have been $8,500,000, whereas, according to popular belief, 12 or more of the original investors had been credited with realizing, if not more, at least as much as this.

No dividends were paid by this company, and it was succeeded early in 1880 by the American Bell Telephone Company, which gave for each share of National stock six shares of American Bell stock, and 8500 shares of the treasury stock were at the same time sold at par. At the close of 1880 there were 540 holders of 59,500 shares, an average of 110 each. Twenty holders of 500 shares or over had in the aggregate 33,190 shares. This was the last year, it is stated, that the majority of the stock was closely held.

The first dividend was paid in 1881, and the American Bell continued business until 1899, during which time the capital stock was increased from $5,950,000 to $25,886,300, of which latter 62,649 shares were held by 61 shareholders in blocks of 500 or over, and the balance, 196,214 shares, was held by 6900 holders. The increase in stock had been sold for cash at various times, yielding the company more than enough in premiums above par to offset the shares that had been issued for patents, inventions and property of the National Bell Telephone Company. Up to 1899, when the business was transferred to the American Telephone & Telegraph Company, there had been over $28,000,000 actual cash paid into the treasury of the company by shareholders as against $25,886,300 capital outstanding. During this time no stock dividend or dividend of surplus in cash to pay for stock issued was made. The company was paying 15 per cent dividends yearly, and in 1899 the stock ranged about $200 a share. The consideration for the transfer of business in 1899 was cash, but, in fact, the American Bell shareholders received two shares of the new company for each share held. The dividends were put on a 7½ per cent basis, and increased in 1906 to 8 per cent, at which they still continue. Since 1900 the stock of the American Telephone & Telegraph Company has been increased from time to time as the business called for money. At the close of 1909 there were in the hands of the public $256,475,300. Such of this stock as was not sold to shareholders at par was sold for cash at a premium, the

highest at $152 per share, or was issued in exchange for convertible bonds at $134 per share. None of the stock has been issued as a dividend, and no cash dividends have been declared to meet payments for stock issues. At the close of 1900 the premiums thus received over the par of the outstanding cash capital amounted to over $14,000,000.

RELATIONS OF LICENSEES WITH PARENT COMPANY.

In promoting and exploiting the business, the method was adopted of enlisting a large number of individual workers; and to insure a common policy and central control, all licenses were issued for small units of territory under restricted terms, confining the business entirely within each territory. The parent company owned and furnished the telephones, had all reversionary interest or rights in the territory, and the right to connect all units with each other for the purpose of forming a universal intercommunicating telephone system, for which latter purpose the long-distance and other toll lines were built. Under these temporary licenses certain rentals or royalties were paid to the parent company for the telephones and other inventions used, and also as compensation for the many other services rendered. When these licenses were made permanent, including all future as well as all existing inventions, and the right to the business within the units of territory, the parent company retained an interest in the business, which was represented by a stock interest in each company. The book valuation of the American Telephone & Telegraph Company's interest in the share capital of the associated operating companies Dec. 31, 1909, was nearly $306,000,000. Of this only $16,000,000 was received through contract or for licenses, the balance, $290,000,000, being obtained on precisely the same conditions that shares have been received by the other shareholders of the company.

COMPETITION OF INDEPENDENTS.

In considering the subject of competition, it is pointed out that in cities with competition the combined Bell and opposition development in 1909, allowing 15 per cent for duplication, was 10.43 per 100 population, while the Bell development in cities without competition was 9.77 per 100 population, or very slightly less. The Bell development alone in cities with competition is 7.8 stations per 100 population, or 2.5 stations less than the combined development, as against the opposition development of 4.53 stations per 100. For Bell exchanges aggregating some 700,000 stations with no opposition, the mean minimum rates for 1909 were $36 per year for business and $23.75 for residences, as against mean minimum rates in 1894 of $68.10 for business and $56 for residences. In cities with competition, where there were Bell exchanges aggregating 550,000 stations and opposition exchanges aggregating 322,000 stations, the mean minimum rates for Bell service were $41.25 for business and $22.80 for residences, the corresponding rates for opposition service being $37.15 and $23.25, respectively.

REDUCTON OF COSTS AND RATES.

The table presented shows that between 1895 and 1909 the average exchange revenue per station for exchange service was reduced from $70 to $31.50, or 55 per cent; the total revenue, including toll revenue, was reduced from $81 to $41, or 50 per cent; operating expenses, including taxes, from $31.50 to $17.10, or 45 per cent; maintenance per station from $26.20 to $13, or more than 50 per cent. The total operating expenses were reduced from $57.70 to $30 per station—that is, not quite one-half—which brought about a reduction in cost to the public of exchange service of over one-half. During the same period the average plant cost was reduced from $260 to $145 per exchange, or about 45 per cent. These statistics are presented in order to establish the claim that reduction in rates followed closely the reduction in expenses, and that the reduction in expenses was the result of the broad policy of development and improvement which the Bell system has followed from the beginning, and which was not forced upon it by competition.

ENTRY INTO THE TELEGRAPH FIELD.

A section is devoted to a discussion of the recent entry into the telegraph field. It is stated that the relation between the telephone and the telegraph is supplementary, one being auxiliary to the other. Telegraphy eliminates the time of transit of correspondence, but is incomplete in that the methods of collection and delivery are slow and primitive. Telephony eliminates distance by placing parties at distant points in direct personal communication with each other, but the expense prohibits its use for the transmission of written messages over long distances. Telegraph operation, as carried on, must have a separate, distinct and entirely different operating organization and equipment from that of the telephone company. Line construction and maintenance are common to both the telegraph and the telephone, and can be combined or performed jointly with economy, since the same wires may be used for both telephone and telegraph circuits at the same time. The differentiation between telephone and telegraph construction and operation begins with the stringing of the wires. Where there is density of message traffic sufficient to keep busy an expert telegraph operator, the telephone cannot be used in competition with the telegraph in handling message traffic; but at some point of less density of traffic the telephone will gradually supersede the telegraph in handling message traffic. The elementary differences in the scope and operation of the telephone and telegraph in handling of telegraph traffic indicate that each will occupy a distinct and well-defined field—the telegraph between centers of density and for long distances; the telephone for short distances and for the collection and distribution between the customer and such centers.

About 65 per cent to 70 per cent of the telegraph traffic is between about 550 cities and towns of 10,000 or more population. The Western Union Telegraph lines reach over 22,000 smaller cities, towns and villages, at most of which commercial telegraph service would not of itself support a telegraph office, the business now being performed necessarily under some joint arrangement, for the greater part with the railroad companies. While these arrangements will be continued, a greatly extended and improved service will be given in connection with the Bell system, with its 5,000,000 stations located at 50,000 cities and towns, most of which will be put in immediate connection with telegraph offices at central points. In this way the electrical transmission of messages will be extended from the actual point of origin to the actual point of destination.

While there are comparatively few places where there is business enough to warrant a "night and day" telegraph service, there is no place where a "night and day" telegraph service is maintained that is not in the center of a Bell system. Practically no Bell exchange is ever closed, and, therefore, there are few subscribers of the Bell system who could not be placed within reach of a "night-and-day" telegraph service. Under the conditions when in full operation, each service will find its level of use; but before any change can be made in the existing telegraph rates, it will be necessary to await the result of studies now being made, as it is claimed that the irreducible cost of handling is so near the revenue received for each commercial message that no reduction in rates will be justified by any probable increase in business. Improvement and extension of existing service, and introduction of new classes or service, will be the first effort. The first of these was the introduction of the night letter, and others will follow.

FINANCIAL OPERATION.

It is stated that a large number of opposition and independent companies were absorbed in the Bell system during the year, the policy being that wherever any opposition company can be legally brought into and made a part of the Bell, it is done if it can be done to the advantage of the public, by and with the assent of all parties interested, including not only the public served, but the public authorities. An effort is being made to make a closer adjustment of the boundaries of associated companies to the commercial and geographical boundaries. This has during the year been completed in the Middle States by bringing together into the New York Telephone Company and the Bell Telephone Company of Pennsylvania the territory

naturally belonging to each. In both cases this was accomplished by a virtual consolidation of the various companies operating in the territory, and in both cases the outstanding obligations after the consolidation showed a considerable reduction below the total outstanding obligations of the various companies combined.

At the end of 1909 there were 5,142,692 subscribers' stations, an increase of 778,063. Of the total 1,508,790 were operated by local, co-operative and rural independent companies or associations having sub-license or connection contracts. The total mileage of exchange and toll wire was 10,480,026 miles, of which 649,308 were added during the year. These figures do not include the mileage operated by connecting companies. Including traffic over long-distance lines, but not including connecting companies, the daily average toll connections was about 517,000, and of exchange connections 19,925,000, as against 463,000 and 18,500,000 connections, respectively, in 1908. During the year the amount added to plant and real estate was $28,700,100. Plant additions in previous years were as follows: 1900, $31,619,100; 1901, $31,005,400; 1902, $37,336,500; 1903, $35,368,700; 1904, $33,436,700; 1905, $50,780,900; 1906, $79,366,900; 1907, $52,921,400; 1908, $26,637,200, making total expenditures for additions to plant during 10 years of $407,172,900. During the year $44,838,900 was applied out of revenue to maintenance and reconstruction purposes.

The associated operating companies, not including the American Telephone & Telegraph Company, show for the year an increase in gross business of about $10,000,000, and in operating expenses and taxes an increase of $2,484,000. Charges to maintenance out of earnings were increased $5,214,000. The balance available for dividends was $30,899,000, or $2,217,000 more than the previous year. The net revenue of the American Telephone & Telegraph Company in 1909 was $30,190,765, out of which dividends amounting to $17,036,275 were paid. After payment of interest, the balance, $6,059,112, shows an increase, notwithstanding the large increase in dividends due to the exchange of convertible bonds for shares. Due to the conversion of bonds and the sale of shares of the company which were held in the treasury, there has been an increase of $97,998,700 in the outstanding share capital. The number of shareholders, 35,823 on Dec. 31, 1909, shows an increase of 9453 during the year. The distribution is general, there being 35,510 shareholders out of the 35,823 holding in blocks of less than 1000 shares each, 1,700,543 shares, or an average of 47 shares each. A recommendation is made that the authorized share capital of the company be increased from $300,000,000 to $500,000,000, none of which will be needed during the current year for ordinary capital expenditures.

The gross revenue collected from the public for telephone service by the entire Bell system of the United States was $150,000,000, an increase of nearly $12,000,000 over last year. The capital stock, funded and floating debts outstanding in the hands of the public at the close of the year were $581,300,000. The valuation of the plant was $557,417,100, an increase of $28,700,000. The surplus and reserve were $95,700,400, an increase of $26,439,700. Against the above-mentioned capital stock the company had property of $612,600,000, an excess of $88,600,000 or 17 per cent. In addition, there is intangible property, such as licenses, contracts, patents and rights-of-way. In every case where the public authorities have appraised the plant of the companies the valuation has been far in excess of the book valuation; it is stated that the obligations of all the companies outstanding in the hands of the public are represented by 150 per cent of property at a fair replacement value of the plant and assets, not including public franchises.

WESTERN ELECTRIC COMPANY.

The business of the Western Electric Company in 1909 showed an improvement of $3,125,053 net over the previous year. Both the foreign business and domestic business, other than that of the Bell system, showed a marked improvement over last year. The business of the company is being concentrated at Hawthorn as fast as possible, and as soon as completed the company will have for sale real estate valued at several millions. Since the close of the year the company has disposed of $5,000,000 two-year 4½ per cent notes, and $8,750,000 of 5 per cent bonds, the proceeds enabling the company to pay off its floating debt and have working capital sufficient for a largely increased business.

Public Service Commission of Vermont.

Vermont is among the commonwealths which have recently established the regulation of public utilities upon a comprehensive basis. In common with other States, Vermont's supervision of corporations furnishing public service was for many years assigned to the State Railroad Commission. This board had jurisdiction over both steam and electric railroads, but the supervision exercised was largely advisory, and the commission had no power of enforcing its orders except through the courts. Four years ago the necessity of broadening the powers of the board was recognized, and in the latter part of the year 1906 the Legislature repealed the then existing Railroad Commission law and enacted a new statute (Chap. 196, Public Statutes), giving the board all the powers of a court of record, both at law and in equity, in matters over which it has jurisdiction, so that the orders of the commission could be promptly enforced.

Under this new law a member of the commission was appointed for six years, a second member for four years and a third for two years, with the provision that at each succeeding biennial term thereafter one member should retire and a new member be appointed for a six-year term. The appointment of the commissioners is made by the Governor, subject to confirmation by the Senate. The chairman of the commission is also appointed by the Governor in the same way from one of the three members of the board. The clerk of the board is appointed by the commission with the approval of the Governor. Under this new law of 1906 the personnel of the board was entirely changed, no member of the former commission being retained on the new board.

In 1908 the Legislature became convinced of the desirability of supervising electric light, gas, power, telephone, telegraph and express companies operating within the State, in addition to the transportation companies already under the jurisdiction of the commission. As Vermont is a comparatively small State and thinly populated, it was deemed best to enlarge the powers of the existing board rather than to establish separate tribunals for miscellaneous public-utility supervision, as in Massachusetts. The Legislature, therefore, passed a law (No. 116, Acts of 1908), which was approved by the Governor on Jan. 20, 1909, and which went into effect on April 1 following, by which the name of the board was changed to the Public Service Commission and the jurisdiction extended as indicated. All the powers of the former Railroad Commission were retained in the above act, with the addition of other powers and duties to be reviewed briefly below.

Under the new law, the existing members of the commission retained their offices as provided in the law of 1906. The board is given supervision over all companies engaged in the manufacture, distribution and sale of gas or electricity for lighting or heating; of all express companies; of all companies owning or operating telegraph or telephone lines within the State, and of all plant and equipment, whether operated by the companies, receivers, trustees, directors or lessees; and also supervision of companies engaged in the manufacture, sale and distribution of energy, so far as relates to their use or occupancy of the public highways and so far as relates to the furnishing of energy for public use. The commission is given the power to examine all plant, equipment, books, papers, accounts and other property of the utilities named; to subpoena witnesses, administer oaths, conduct examinations and proceed in cases of contempt after the manner of the courts. The board is given the right to enter the premises of any company subject to its supervision. The companies are required to furnish the commission with whatever information it desires concerning their condition, operation, management, expenses, rates, contracts,

obligations, cost of production, maintenance and financial standing. The commission is not, however, unless required by law, to give publicity to such information except as may be necessary in its reports to the Legislature or in judicial proceedings.

In case a company refuses access to its books and papers, or makes false returns, the law provides for a fine, and in case of persons testifying under oath before the board, the usual laws relating to perjury apply. In case of accidents resulting in loss of life or in incapacitation, the superintendent of any line or plant under supervision is required to send a written report immediately to the commission, which is required to inquire into the cause of every accident and if necessary make a public investigation, as in the jurisdiction of the board over railroads. Complaints concerning any claimed unlawful action or neglect of corporations under the board's supervision may be prosecuted through the State attorneys. The commission is given jurisdiction over the charters of all corporations under its supervision and has similar jurisdiction over the purity, quantity and quality of any product of a company under its supervision, the providing of standard commercial units of product or service, the manner of operating the service, the price, toll, rate or rental charged, the sufficiency and maintenance of proper systems of equipment, and, when public safety and welfare require, the location of electric wires underground. The board also has entire supervision of securities of all kinds by companies under its jurisdiction and the power to order changes in rates, measurements and practices, to accord with what is in its judgment reasonable and without discrimination. Appeal to the Supreme Court of Vermont is permitted by any party who feels himself aggrieved by an order or decision of the commission. But such appeal does not vacate the orders or decrees of the commission unless a special order is made by the Supreme Court, or a judge thereof, suspending the execution of the order of the commission.

Public-utility companies may petition to the board for the right of eminent domain and the board is given final judgment in such matters, except as an appeal to the Supreme Court is allowed from the orders and decrees of the board. Any person or corporation aggrieved by any order or decision of the municipal authorities relative to locations may appeal to the board as a final tribunal, subject to the usual appeal to the Supreme Court. Corporations subject to the supervision of the commission are not allowed to increase their securities except such as are payable within one year from the date of the issue, without application, hearing and the consent of the board. The Attorney-General of the State is required to represent the commonwealth at such hearings. All companies under the supervision of the board are required to file schedules of rates with the commission and to maintain schedules open for public inspection at their offices.

On account of the newness of the public-service law and the previous lack of experience with such extended regulation the policy of the commission is to bring about the needed changes gradually. So far as the working of the railroad law of 1906 is concerned, the results are reported to be most satisfactory, many improvements having been accomplished by consultation and informal discussions with the transportation companies, who have co-operated most heartily with the board. In relation to electric light and power companies, many complaints that have been filed have been adjusted without the necessity of a public hearing, through correspondence or personal consultation. Perhaps the most important matter which the board has under way with electric companies is the problem of making high-tension wires safer in the more congested districts. This matter has been taken up in the cities of Barre and Montpelier, and after due hearing, with expert witnesses in attendance, it was agreed that the electrical engineers of all the companies concerned should formulate plans in detail for a complete readjustment of wiring in these cities, to be passed upon by the expert of the board for report to the commission. The matter of placing the wires underground was also considered, but in view of the great cost of the undertaking it did not appear advisable to begin this character of work at the present time. It is the intention of the commission gradually to carry on this work of improvement in wiring conditions throughout the whole State.

The chairman of the commission, John W. Redmond, is a native of Charlotte, Vt. He attended the University of Vermont, graduating in 1886, and is a lawyer by profession. Since 1904 Mr. Redmond has been reporter of decisions for the Supreme Court of Vermont. Commissioner Eli H. Porter is a native of Whitingham, Vt., and is a graduate of Powers Institute, Barnardston, Mass. He was a member of the Legislature in 1892 and 1906, has been town auditor, school director, justice of the peace and postmaster, from 1893 to 1897, in Wilmington. He is president of the Wilmington Savings Bank. Commissioner S. Hollister Jackson, of Barre, is a native of Toronto, Canada, and is a graduate of the University of Toronto. He was State's attorney for Washington County in 1904-06 and was a member of the Legislature of 1906, being a lawyer by profession. Mr. Rufus W. Spear, clerk of the commission, is a native of Stanstead, Canada, having been educated in Minneapolis and Winnipeg. He came to Newport, Vt., in 1893, and up to the time of his appointment as clerk was register of probate for Orleans County. The postoffice address of the commission is Newport, Vt.

Maryland Public Utility Bill.

The Democratic floor leader of the Maryland House of Delegates has announced that the committee would in all probability report the utilities act to the House during the latter part of this week. Chairman Benson said that he was in favor of the passage of a public-utilities act applicable to all public-service corporations, but it is not known whether or not he will support the bill which is pending in his committee. It is believed that he has some amendments which he proposes to offer to the bill. When the public-utilities act, which was drafted by Attorney-General Isaac L. Straus, was introduced in the House it was referred to the judiciary committee. It was held by this committee for about three weeks, during which both its friends and opponents were heard. Representatives of a number of the leading public-service corporations in the State appeared before the committee and not only opposed the passage of the measure, but also protested against the creation of a public-utilities commission at all, declaring that there was no work for it to do in Maryland.

After a number of conferences with Mr. Straus, the act was reported favorably, with about 40 amendments. These consisted of changes in verbiage. The committee made a number of changes in the salaries of the officials named in the act. The salary of the chairman of the proposed commission is decreased from $8,400 to $7,000 a year, while that of the other two commissioners is decreased from $7,500 to $6,000. The pay of the secretary is increased from $2,500 to $3,000 a year, while that of the general counsel is decreased from $5,800 to $4,800 a year. The friends of the bill believe that the measure should have been considered by the House without any reference to the ways and means committee, but as it carries an appropriation of $75,000 a year from the State it was demanded by others that it should be considered by this committee. The Republican bill for a public-utilities act, which was introduced in the House by Mr. Pairo, the Republican floor leader, is also before the ways and means committee. The main feature of this bill is the absence of specific rules, leaving to the commission the treatment of conditions as they may arise. The bill is noted for its brevity, when the importance of the subject is taken into consideration. It provides that the members of the commission shall be elected by the people instead of being appointed by the Governor, as is the case in the Straus bill, and holds that one of them must be a member of the minority party. There are no such restrictions in the Straus bill, the Governor being given the right to name the commissioners irrespective of political affiliations.

A third public-utilities bill made its appearance at Annapolis

last Friday, when Mr. Main, of Baltimore city, introduced one drafted by the Reform League. This bill was referred to the judiciary committee, but will be reported early this week and sent to the ways and means committee with the other two. The Republicans, led by Mr. Pairo, will endeavor to have their bill passed instead of that of the Democrats, but this is expected to be a futile attempt. It is believed that the Republicans will fight to the end for an amendment to any bill which will provide for minority representation. It is said that four-fifths of the members of each legislative branch are in favor of public-utility legislation of some kind. Governor Crothers is sure the Straus bill will go through, and he proposes to do what he can to hurry it through.

Opposition to St. Lawrence Hydroelectric Development.

The private bills committee of the Canadian Parliament had under consideration on March 9 the bill to incorporate the St. Lawrence Power Transmission Company, which is the company that intends to carry on the hydroelectric development work at the Long Sault Rapids in the St. Lawrence River, to which strenuous objection has been offered by the Hydro-Electric Power Commission of the Ontario Government and the marine interests of Montreal and other ports.

A compromise was finally effected by the incorporation of certain amendments in the bill declaring that the act shall not come into force until proclaimed by the Governor in council after all the plans and the general purposes of the undertaking and its effect upon the public interests have been carefully considered. To prevent an indefinite tieing up of transmission privileges in the districts affected, the promoters of the bill consented to the insertion of a clause declaring that the company must begin work on its transmission lines within one year from the date of the proclaiming of the act, and must complete the work within three years. A third amendment was made prohibiting the exportation of energy. The bill was then reported to the House, where it will probably be passed and become law in due course.

Important Decision by Wisconsin Commission on Central-Station Valuation and Rate-Making.

After nearly two years of exhaustive investigation the Railroad Commission has handed down its decision in the case of the State Journal Printing Company *et al.* vs. Madison Gas & Electric Company. This case was one of the first, and one of the most important, to be tried under the Public Utilities Law. It therefore practically sets a precedent for rate making as applied to public-service utilities in Wisconsin. Many questions as to the elements which enter into a reasonable schedule of rates for gas and electric service are disposed of, with the result that this decision will probably affect the determination of many public-utility rate cases now pending before the commission. The formal hearings were held during the month of April, 1908, although informal conferences have been held during the two years past.

The petitioners alleged that the rates were excessive; that the heating and lighting values of the gas were low due to adulteration; that the electric lighting service was deficient and irregular. The numerous tests and inspections made by the commission from time to time during the past two years show that the quality of service rendered by the defendant is now entirely satisfactory, although this improvement was made since the filing of the complaint.

Although the most disputed questions at the time of the formal and subsequent hearings related to the valuation of the company's property, this case called for an interpretation of practically every question affecting the determination of reasonable rates. President A. C. Humphreys, of Stevens Institute; Messrs. H. L. Doherty, A. E. Forstall, R. B. Brown and others testified as experts on behalf of the company.

The company claimed that it was entitled to earn interest upon a total valuation of $1,300,000, the value that it placed upon its plant. The value of the company's property, as determined by the engineers of the commission, was $412,000 for the gas plant and $535,000 for the electric plant, or a total of $947,000. These valuations included, in addition to the inventoried valuation, an item of 12 per cent to cover cost of interest, engineering, legal expenses, etc., during construction, and also a total working capital of $50,000. The company's experts testified that 18 per cent was the minimum which should be allowed for the former item, and claimed that $100,000 was none too low a figure for the second item. The decision goes into detail in regard to these matters, and the values arrived at are the result of very careful investigation.

Considerable argument was advanced by the company to prove that at least 15 per cent should be allowed on account of the fact that the plant was built piecemeal instead of in one large continuous operation, but the commission stated that all this had been allowed for in the inventoried valuation.

Perhaps the chief point of controversy was the question of "going value." President Humphreys stated that, in his opinion, the going value of the Madison plant should be at least $300,000; Mr. Forstall and Mr. Brown considered $250,000 a fair value. A considerable portion of the decision is devoted to a review and discussion of this testimony and a discussion of the subject from the commission's standpoint. The commission says in part: "Investigation of the facts involved makes it quite obvious that justice between the investors on the one hand and the consumers on the other require that, in valuing public utilities, consideration should be given to the amounts expended by the former in building up the business of such plants. This is especially true when the earnings of a utility have not been sufficient to meet reasonable expenditures for development of the business and to cover operating expenses, depreciation and reasonable returns on the investment. When the losses incurred in building up a business are due to such delays in securing the required amount of business as cannot be reasonably avoided and have not been covered by subsequent surplus earnings, it is difficult to escape the conclusion that they must also be regarded as one of the elements that should be considered in appraising the plants and in fixing their rates. By this is not meant, however, that defects from operation can equitably be taken into account when such defects are due to abnormal conditions, such as bad management, extravagance, unduly high capital charges," etc. "Nor can a purely arbitrary value be considered a going value; whether or not a plant is entitled to a going value depends entirely upon the conditions in each particular case."

After careful consideration of the financial condition of the company, the commission concludes that its plant has no going value over and above the cost of reproducing these plants new. The method of arriving at the above conclusion was as follows:

The cost of the plants at the time they were acquired by the respondent was ascertained as closely as possible. This cost, together with the amount expended for new extensions, increases in land values, depreciation, and interest and profit on the investment were charged up against the plant for the first year, while the plants were credited with the net earnings for the year. The balance then indicated the value of the plant at the end of the first year for an assumed reasonable interest on the investment. This plant value was then used for the next year's calculations. The same operation was repeated each year from 1896, when the plant was acquired, until 1908. The values of the electric plant as determined in this way are shown below for the last three years:

	1906.	1907.	1908.
Value of plant	$369,698	$380,296	$453,768
Additions to depreciable property	13,138	81,707	13,887
Increase in land value	1,620	1,620	.....
Depreciation	20,605	21,281	25,482
Interest at 8 per cent	29,576	30,424	36,301
	$434,637	$515,328	$529,438
Net earnings	54,341	61,560	78,987
Value of plant at end of year	$380,296	$453,768	$450,451

In these calculations the appreciation in real estate is recog-

nized. Depreciation was figured on depreciable property only, at a rate of 5.57 per cent on a straight line basis.

At the end of the period the value of the electric plant computed in this way on an 8 per cent earning basis was $450,451, as against the commission's valuation of $535,000. Consequently, the plant has been earning more than a reasonable return on the investment and therefore has no going value. The cost of reproduction now represents the maximum value that should be placed upon the plant for rate-making purposes.

The decision gives careful consideration to the much-mooted question as to what is the proper rate of return in the corporations supplying public service. It lays down the general rule that "this is determined by the ordinary rates for capital similarly invested in other enterprises, under similar conditions, and sufficiently large to encourage investors to enter such enterprises." At the same time it recognizes the fact that certain elements of risk are involved and that consequently there is a speculative feature about them for which their owners are entitled to have something in the way of speculative gains. The commission considers that from 7 per cent to 7.5 per cent is a reasonable rate of return on a fair valuation of a gas plant and 8 per cent on the electric plant.

A large portion of the decision is devoted to the analyses of costs and their apportionment over consumer, capacity and output, for each class of service rendered by the company. Operating expenses were analyzed from 1896 to date, and critical cost analyses made for the last three years. Perhaps the most exhaustive investigation of consumer data that has ever been attempted was made in connection with this case. The monthly bills of some 4000 gas and electric consumers for the last several years were examined and statistics prepared which show the relation of consumers, connected load, and current consumption to the cost of service. The per cent active load has been determined for each class of consumer, as well as the ratio of maximum demand to connected load. The units costs (kw-hours) of service are given below:

	Capacity.	Output.	Total.
One hour's use per day.....	8.13 cts.	4.52 cts.	12.65 cts.
Two hours' use per day.....	4.07 cts.	4.52 cts.	8.59 cts.
Three hours' use per day.....	2.71 cts.	4.52 cts.	7.23 cts.

The schedule of lighting rates, as ordered by the commission, is as follows: 14 cents net per kw-hour for the first 30 hours' use per month of the active connected load; 8.5 cents net for additional energy equal to or less than next 60 hours' use, and 5 cents net for excess over 90 hours' use per month; sign and outline lighting yearly contracts, 4.5 cents per active 50-watt lamp per month, plus 5 cents net per kw-hour for energy consumed.

Consumers are classified with respect to active connected load as: Class A, dwellings; Class B, business and industrial places; Class C, public buildings, churches, hotels, schools, small industrial establishments, etc. In Class A, 60 per cent of the total connected load is deemed active where the total connected load is less than 500 watts, and one-third of all over this amount is considered active. In Class B, 70 per cent is considered active, and in Class C, 55 per cent. Outline lighting is all active. The University service is put in a separate class, of which 30 per cent is considered active. Power consumers are to pay 50 cents per month active horse-power capacity, plus 4 cents per kw-hour for current. The active horse-power is governed by the size and number of motors.

The minimum bill for power consumers is $1.50, and for lighting consumers, $1. If bills are not paid after the thirteenth of the month, one cent per kw-hour over the net charges is allowed the company. The new schedule of rates has for its purpose to make a more equitable adjustment of rates between different classes of consumers, besides giving a general reduction of about 14 per cent over the old schedule.

The probable revenue under the new system has been very carefully worked out by recalculating each consumer's bill for the past few years. On the basis of 1909 conditions, the company will suffer a loss of revenue of $25,000.

Discussion on Industrial Education at Boston.

The Boston branch of the American Institute of Electrical Engineers and the Boston Section of the American Society of Mechanical Engineers held a joint meeting at the Massachusetts Institute of Technology on the evening of March 11. The speaker of the evening was Mr. Magnus W. Alexander, who read a paper on the training of men. The author mentioned certain conferences recently held at the Lynn Works between the General Electric Company and representatives of the engineering schools. These resulted in much good, and criticisms were freely exchanged at the time of the visit. Co-operation with the secondary schools and a definite educational policy are most desirable. Mr. Alexander pointed out the need of experience in the drawing-room as well as the testing-room for the technical graduate, and he closed with the statement that the industrial training at Lynn, fully described in the paper, is likely to result in the rapid progress of the men.

In the discussion Prof. Ira N. Hollis pointed out that the movement toward industrial education in connection with the factory itself is bound to extend. He also emphasized the value of commercial contact during the regular college or engineering course. The chief hope of the country lies in the better industrial training of the workmen. The time is coming when every industry must have its graduate school.

Mr. H. S. Knowlton reviewed the educational work performed by the Boston Elevated Railway Company in connection with the monthly meetings of its car-house foremen and division superintendents and the weekly meetings of its car-house and shop employees. The technical details of the equipment are thoroughly discussed at these meetings, often with the aid of illustrations and parts of apparatus which can be examined effectively in connection with the study of defects occurring on the system. The opportunity also exists in connection with the establishment of piece work to train the shop employee toward higher efficiency.

Major Otis touched upon the importance of the educational work at Lynn and reviewed early apprentice experiences. The machine has taken the place of the hand in much modern work. Not enough of our young men are seeking to learn trades. The average mechanic to-day is not as widely experienced as his predecesors. The question is whether our common schools are too wide to be deep enough. Major Otis concluded with commendation of the U. S. Naval Academy in training engineers, and voiced the value of manual training in secondary education.

Mr. Chas. F. Parks outlined the value of the evening work of the Lowell Institute School for Industrial Foremen, which has now had 183 graduates. A two-year course is maintained and there are now 90 first-year and 60 second-year students. Men who have had practical experience get the most out of the training. Grasp of practical details can best be learned in the shop, but fundamental principles can best be taught in the regular schools. The mechanical industries should not be called upon to furnish training outside their general work.

Mr. Geo. C. Ewing described the course in operation at the East Pittsburgh factory of the Westinghouse Electric & Manufacturing Company. The tendency is toward higher pay for apprentices.

Mr. D. J. Baker spoke in favor of the shop course at Lynn and the value of such experience in the midst of a technical course also. He considered repetitive work very valuable, especially in the training of the best kind of executives. The need is for competent, able foremen. The difference between a poor and a good foreman may easily represent $37.50 per day to a company.

In closing, Mr. Alexander said that he had no intention of abolishing the trade schools. Those who criticise repetitive work forget that the jigs and fixtures have to be produced by skilled mechanics. A certain amount of repetitive work is absolutely necessary in training the skilled workman. The shop course appeals especially to the grammar and high-school student who can go no further.

Massachusetts Commission News.

The Gas and Electric Light Commission has been petitioned by the Mayor of the city of Newburyport to reduce the prices for gas and electrical service charged by the Newburyport Gas & Electric Company. A hearing will be given. The board recently gave a public hearing upon the petition of the Gardner Electric Light Company for the right to issue new stock to net $115,000, including 200 shares of common and 850 shares of preferred, for paying indebtedness and providing for additions to the system. About $23,500 is to be applied to extensions and enlargements in connection with the distribution of Connecticut River energy by the Gardner company. The latter company has recently come under the control of the Connecticut River Transmission Company. Mr. Stephen E. Young represented the Gardner company as counsel. He stated that a contract has been made with the transmission company whereby the latter will furnish the former with energy at a very low rate (Mr. Harriman stated this to be 1.1 cents per kw-hour), thus making it possible for the Gardner company to extend its business. The $23,500 required for plant extensions and enlargements is necessary in the construction of transmission lines for reaching customers, for a regulator and switchboard items. General Manager Richards stated that the estimated cost of new construction in connection with the local distribution of the Connecticut River energy at 6600 volts is as follows:

Feeder regulator, installed	$2,200
Ashburnham line construction	3,500
Overhead lines, around Gardner, about 4 miles	8,000
Switchboard apparatus in station	2,000
Future extensions	7,800
Total	$23,500

Under the new arrangement the Gardner company sells energy for as low as 1.5 cents per kw-hour to customers with a demand as small as 100 hp. Mr. Harriman said that in his opinion this is the lowest rate at which energy in that quantity is sold in the State of Massachusetts, and the Gardner company has been able to make this rate because of the close relations existing between it and the Connecticut River Transmission Company. The stockholders of the Gardner company were in many cases interested also in the local manufacturing industries and realized the benefit that low-priced energy would be to the town. As a result of repeated conferences the stockholders voted to deposit their stock with Messrs. Whittemore, Harriman and Geo. B. Baker as trustees, with an 8 per cent dividend guarantee. The hearing closed without opposition to the company's plans.

The selectmen of the town of Westborough have petitioned the Railroad Commission for a reduction in the fare between that municipality and the city of Worcester from 20 to 15 cents, on the line of the Worcester Consolidated Street Railway Company. The petitioners contend that the charter of the Westborough & Worcester Street Railway Company, now leased by the Consolidated, specifies a 15-cent fare. The distance involved is about 12 miles.

The Interstate Consolidated Street Railway Company has petitioned the Railroad Commission for the right to carry freight in the towns of Seekonk and Attleboro, and the Milford, Attleboro & Woonsocket Street Railway Company has petitioned for the same right in the towns of Milford, Hopedale, Franklin, Plainville, Wrentham, Mendon and Bellingham.

Massachusetts Legislative News.

The committee on street railways has recommended that the bill to require the Boston Elevated Railway Company to establish a free transfer station at the intersection of Massachusetts and Huntington Avenues, Boston, be referred to the next Legislature, in order to give the petitioners opportunity to bring the matter before the Massachusetts Railroad Commission for hearing and adjudication.

The bills to allow the Worcester & Southbridge Street Railway Company to acquire and operate a line of street railway in Thompson, Conn., and to authorize the Springfield Street Railway Company to do the same thing in Suffield, Conn., have been ordered to a third reading in the Senate. The Senate has given a third reading to a resolution to provide for an investigation and report by the Gas & Electric Light Commission in connection with the transmission of electricity within the commonwealth, and especially with respect to the transmission of electricity in bulk and to such lines as must pass through two or more cities or towns in order to connect a source of supply with a suitable market; to examine the laws relative to the location, construction, maintenance and use of transmission lines and authority of the above board in respect to them, and to submit its conclusions to the next Legislature, with such recommendations as it deems necessary. The intent of this measure is to bring about a somewhat closer supervision of transmission companies than now exists in Massachusetts.

The Senate has accepted the adverse report of the committee on Street Railways relative to the bill to provide for State and city ownership of street railways, and the Senate has concurred in the reference to the next Legislature of the bill to protect users of telephone and telegraph service from improper and unjust charges. The adverse report of the committee on mercantile affairs upon the bill to provide a more uniform system of telephone rates in the town of Norton has been accepted by the Senate, and the same action has been taken upon the bill accompanying the petition of C. W. Rowley to regulate the use of telephones and prohibit the unreasonable discontinuance of telephone service.

The committee on street railways has voted leave to withdraw the bill making it unlawful for municipal authorities to grant street railway locations at the sides of highways within one mile of the center of any city or town of over 5000 inhabitants, or within one-half mile of the center of any city or town of less than 5000 population. The same committee has reported adversely upon the bill amending the law relative to the heating of street railway cars to the effect that the Railroad Commission instead of the district police shall enforce the existing act.

The committee on public lighting has drawn up a bill providing that no application of a gas or electric light company to issue stock shall be made unless authorized by the stockholders within four months of the application to the Gas and Electric Light Commission, and that all proceedings relative to the increase and all rights of the stockholders to subscribe for new shares shall become void unless the directors give notice of the increase within 60 days of the final action of the commission. The report of the committee on street railways in favor of the bill to permit street railways to purchase street railways owned by foreign corporations has passed to a second reading in the House. The reports of the committee on public lighting recommending reference to the next Legislature of the bills prohibiting or regulating charges for the use of gas and electric meters have been placed in order for a first reading. The bill to extend the time for the removal of overhead wires in Pittsfield has been read a third time. The House has accepted in concurrence the adverse report of the committee on mercantile affairs upon the Coghlin bill relative to licensing electricians.

Hearings have been concluded by the committee on metropolitan affairs upon the bill to prohibit further construction of elevated railways in Boston, the bill to provide for the extension of the Washington Street tunnel, Boston, with the removal of the existing elevated structure, and the bills requiring the removal of barriers between the Washington Street and East Boston tunnel platforms at State Street, Boston. Upon the first of the above bills the Boston Elevated Railway Company showed that such an act would attempt to bind future Legislatures, and with little purpose, and that it would also attempt to repeal the act authorizing the extensions of the Boston Elevated to Malden, Everett, Main Street, Cambridge and East Cambridge. The second bill has been declared unconstitutional by the attorney-general of the State. The company is planning a method of transfer at State Street which will do away with the present difficulties.

New York Public Service Commission News.

The Interborough Rapid Transit Company has prepared a third set of plans for the construction of subways in New York which will shortly be submitted to the Public Service Commission of the First District. These plans contemplate an extension from the present subway station under Forty-second Street, at Grand Central Station, north under Madison Avenue to the Harlem River, thence two branches in the Bronx, one of which would extend up Jerome Avenue, the other turning east would reach Pelham Bay Park. The plan also proposes a subway under Seventh Avenue from the present subway at Times Square, south to the Battery, where it would join a tunnel under East River to Pineapple Street, Brooklyn, with probable extensions out Flatbush Avenue to Prospect Park. The Interborough will not include in these proposals the purchase of the Steinway tunnel, and it is understood that the third tracking of the elevated lines will be left optional to the commission. The Interborough will submit these plans as "Extensions" of the present system, which could be permitted by the authority of the commission without outside bidding. It is doubtful, however, if the commission will consider such extensive plans as extensions, and this question will be submitted to the city authorities for determination. The commission is strongly in favor of the Broadway-Lexington Avenue plan, and for this reason is not likely to favor the Interborough's proposals.

At the hearing before the commission last week on the traffic conditions on the Elevated lines Frank Hedley, general manager of the Interborough Company, declared that his company was glad to have any defects in service pointed out, and was anxious to do everything in its power to carry out the suggestions made by the commission. Mr. Hedley said that the company had recently received 70 new cars and was in the market for 100 more cars. Mr. Hedley said he did not think side-door cars would work well on the elevated, but that if the commission so desired they would be given a trial. D. S. Turner, engineer of the commission, presented tabulations showing that counts made at various times gave many more passengers carried than there were seats available. In one instance, on the Third Avenue Elevated, between 7:30 and 8 o'clock there were carried 11,400 passengers with only 7000 seats available.

By a vote of 3 to 2 the commission decided last week that a 10-cent fare to Coney Island over the Brooklyn Rapid Transit Company was not excessive. The commission, however, takes the position that when the Fourth Avenue (Brooklyn) subway is constructed that a 5-cent fare will be all that is necessary. The decision in the Brooklyn Rapid Transit case was based entirely upon the question of earning sufficient returns upon the valuation of the property recently made by Bion J. Arnold.

The Public Service Commission has issued an order authorizing the Coney Island & Brooklyn Railroad Company to issue $151,000 of new bonds. The original application was for $352,000.

The Public Service Commission has given its final hearing upon the application of the New York Edison Company for permission to issue $5,349,400 new stock. A decision is expected within a few days.

A delegation of Brooklyn bankers and business men has submitted a proposal to the commission for the construction of a subway and tunnel from the City Hall, Manhattan, under the East River to Borough Hall, Brooklyn. The route of this proposal is about midway between the present East River tunnel and the Brooklyn Bridge.

The Public Service Commission, Second District, has authorized the Putnam & Westchester Traction Company to issue first-mortgage, 5 per cent, 30-year gold bonds to the amount of $11,000, the proceeds to be used to discharge outstanding obligations of the company.

The commission has approved of the plans submitted by the New York State Railways for the crossing of its tracks over the tracks of the Charlotte Branch of the New York Central & Hudson River Railroad in Lyell Avenue in the city of Rochester, with slight modifications suggested by its inspector of electric railroads.

The commission has consented to the transfer by Mr. Charles P. Dickinson to Mr. Charles H. Stokes of the electric lighting plant in the town of Warwarsing, Ulster County, together with the franchises granted by the town board of Warwarsing. It has also consented to the transfer by Mr. Charles P. Dickinson to Mr. Arnold P. Dickinson of all rights and franchises granted by the town board of Hurley, Ulster County, and by the town boards of Rosendale and Marbleton, Ulster County, and permission to sell an electric lighting plant in the towns mentioned.

The commission has authorized the Corning Gas & Electric Company to exercise franchises granted it by the town of Corning, Steuben County, to operate gas and electric service plants in the hamlet of Centerville, located in that town.

It has authorized Urban O. Webb, of Edward, St. Lawrence County, to construct an electric lighting plant in that village and to exercise franchise granted by the village.

It has also authorized the North Syracuse Light & Power Company to construct and maintain an electric lighting plant in the towns of Salina, Clay and Cicero in Onondaga County.

The commission has granted the application of the village of Port Byron to engage in the furnishing of electricity for light and power purposes to the residents of that village and for general commercial purposes. It has received an application from the Hudson Valley Railway Company for approval of the construction of a high-tension electrical transmission line from Halfmoon, Saratoga County, to the city of Troy. It has received an application from the Catskill Traction Company which has succeeded to the property rights and franchises of the Catskill Electric Railroad, of Catskill, N. Y., sold at foreclosure on Jan. 12, 1910, asking for consent to mortgage its property and franchise securing a bond issue to the amount of $200,000 and for permission to issue presently $60,000 in bonds in part payment of the purchase price of the property of the Catskill Electric Railroad, also for leave to issue $12,000 capital stock to the incorporators, which has been paid for in cash and $48,000 par value capital stock to W. C. Wood in payment of the balance of the purchase price of the Catskill Electric Railroad property.

The commission has denied the application of the New York Central & Hudson River Railroad Company for an extension of time of one year on the order of the commission requiring the operation of oil-burning locomotives in the Adirondack Forest Preserve. The commission, however, has amended its order which required the complete installation of oil-burning locomotives, on April 15, 1910, as follows: Two oil-burning locomotives are to be placed in service April 15, three on May 1, ten on June 1, ten on July 1 and the remainder by Aug. 1.

AMERICAN ELECTRICAL ENGINEERS—VI.

Prof. Dugald C. Jackson.

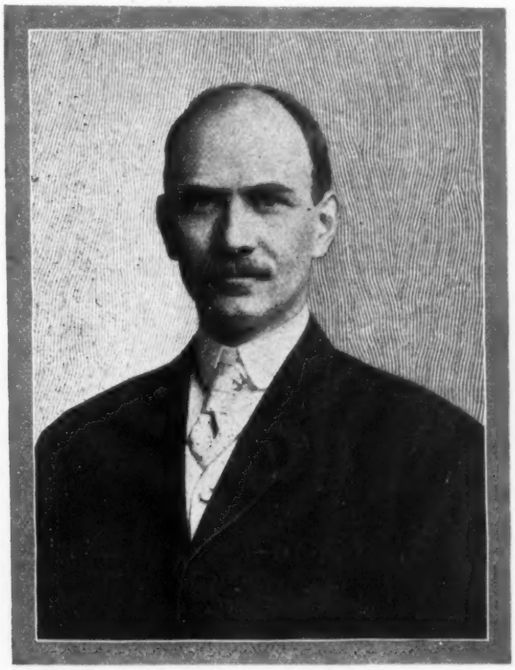
Dugald Caleb Jackson was born at Kennett Square, Pa., in 1865, and is of Quaker descent. He prepared for college at the "Hill School," Pottstown, Pa., and was graduated in 1885 with honors from the course in civil engineering of the Pennsylvania State College, where his father, Josiah Jackson, had for a number of years been professor of mathematics. He then spent two years at Cornell University, one as a Fellow in electrical engineering, and the other as instructor in physics.

In 1887 he joined with Mr. J. G. White and Prof. Harris J. Ryan in forming the Western Engineering Company, a contracting company with headquarters at Lincoln, Nebraska, which constructed a number of the earliest electric railways and alternating-current electric light plants in the west, besides several direct-current plants. He later entered the employ of the Sprague Electric Railway & Motor Company as an assistant to the chief engineer, with offices in New York City, and continued with that company until its absorption in 1891 by the Edison General Electric Company, of which he was made chief

engineer of the central district, with headquarters in Chicago.

In the autumn of 1891 he resigned the latter position to take the professorship in electrical engineering at the University of Wisconsin, which had just then established that chair. During the 15 years he was in that position Prof. Jackson developed and exceptionally efficient and well-manned department, and one which has had a large influence on the development of American electrical engineering education to its present stage.

After leaving the Edison General Electric Company to go to the University of Wisconsin, Prof. Jackson established a practice as consulting engineer and adviser for operating and manufacturing electrical companies. Later the business expanded to such an extent that he formed a partnership with his brother, William B. Jackson, with the firm name of D. C. and Wm. B. Jackson, and with offices in Chicago and Boston. Many of its reports are well known in electric lighting and telephone circles, and are evidence of Prof. Jackson's ability to apply to the practical problems of engineering the same forcefulness and judgment which have characterized his educational work. In August, 1906, he was appointed Professor of Electrical Engineering in the Massachusetts Institute of Technology, and moved his residence to Boston in February, 1907.



Prof. Dugald C. Jackson.

Prof. Jackson has been granted a number of patents on inventions which have entered into commercial use. The first of these, taken out in 1888, was a joint patent with Professors W. A. Anthony and Harris J. Ryan, making the original disclosure of the repulsion motor with closed coil armature windings, and may fairly be ranked with the classics among electrical patents. He is the author of "A Text Book on Electricity and Magnetism and the Construction of Dynamos"; "Electricity and Magnetism: A Series of Lessons"; and jointly with Prof. J. P. Jackson, of Pennsylvania State College, a brother, of "Alternating Currents and Alternating-Current Machinery" and "An Elementary Book on Electricity and Magnetism and Their Applications."

Prof. Jackson has been president of the Society for the Promotion of Engineering Education, vice-president of the American Institute of Electrical Engineers and vice-president of the Western Society of Engineers. In addition to these societies, he is a member of The American Society of Civil Engineers, American Society of Mechanical Engineers, Franklin Institute, The National Electric Light Association, The American Street and Interurban Railway Association, Société Internationale des Électriciens, etc. He is a member of the St. Botolph, University, Technology, City and Brae Burn Country clubs, of Boston; the Engineers' Club of New York; the Union League and Engineers' Club, of Chicago, and the Milwaukee Club, of Milwaukee. He is also a member of the Chamber of Commerce of Boston, an important civic as well as commercial organization, and holds membership in its important Committee on Public Utilities. His work in the latter capacity is giving expression in an efficient and practical form to his often-stated belief that the engineer must sooner or later be depended upon by our governing bodies for aid in solving the difficult problems associated with public utilities.

He became an associate member of the American Institute of Electrical Engineers in May, 1887, and a member in June, 1890, and has always taken an active part in its affairs. He is at present a member of the Board of Examiners, Educational Committee, Edison Medal Committee, United States National Committee of the International Electrotechnical Commission, and is also chairman of the Boston A. I. E. E. Section. He was a member of the International Bureau of Awards at the Columbian Exposition in 1893 and of the Pan-American Exposition in 1901.

CURRENT NEWS AND NOTES.

Indiana and Michigan Joint Telephone Meeting.—The Michigan and Indiana Independent Telephone Associations will hold a joint meeting at South Bend, Ind., May 11 and 12.

Chicago Engineers' Club.—At its annual meeting on March 11 the Chicago Engineers' Club elected officers as follows: President, Mr. James O. Heyworth; vice-president, Mr. Charles H. Cartlidge; secretary and treasurer, Mr. Robert I. Randolph.

Nevada Tungsten Deposits.—Arrangements are being made for mining the extensive deposits of tungsten ore near Round Mountain, Nevada. It is claimed that this deposit is 25 per cent richer in tungsten than the ore at Boulder, Col., from which place is obtained most of the American tungsten.

Court of Patent Appeals.—A bill creating a court of patent appeals was passed by the United States Senate on March 9. It authorizes a bench of five members. The chief justice will be nominated by the President and serve for life, and the other four justices will be selected by the Chief Justice of the United States Supreme Court from among the Circuit and District Court judges of the country, to serve for six years. The court will have jurisdiction of patent cases exclusively.

Düsseldorf Metallurgical Congress.—At the International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology, to be held in Düsseldorf from June 18 to 23, 1910, a number of papers of electrical interest will be presented. Among these are a paper by Chief-Engineer Philippi, Berlin, on "Electricity in Mining"; one by Chief-Engineer Maleyka, Berlin, on "Electricity in Metallurgy"; one by Prof. Dr. Neumann, Darmstadt, on "The Present Status of Progress of the Electro-Steel Processes in Germany," and one by Dr. Bornemann, Aix-la-Chapelle, on "Electric Conductivity of the Metallic Alloys in the Fluid Condition."

Campaign Against Projecting Electric Signs in Chicago.—Projecting electric and other signs have been removed from State and Madison streets in the central business district of Chicago on complaint to the Mayor, and now a similar effort is under way to cause signs of this character on Clark Street, between Randolph and Van Buren streets, to be taken down. The Mayor has advised the protesting Clark Street property owners that the desired action will be taken if a frontage majority in favor of the change can be obtained. The objection to the signs projecting from buildings is that they are an obstruction to firemen in case of fire and also that they are unsightly.

Arkansas Association Public Utility Operators.—The next convention of the Arkansas Association Public Utility Operators will be held at Pine Bluff, Ark., on April 27, 28 and 29, with headquarters at the Jefferson Hotel. Mr. B. C. Fowles, manager of the Pine Bluff corporation, is president of the association, and Mr. J. E. Cowles, chief electrician of the Little Rock Railway & Electric Company, is secretary.

Stability of Public Utility Earnings.—In a recent address Mr. Arthur W. Harris, of the New York banking firm of Harris & Company, stated that during the 12 months following the 1907 panic the gross earnings of 60 public service corporations, the bonds of which were handled by the firm, increased by more than 7 per cent. During the same period there was a marked decrease in the earnings of steam railroads and almost all other similar industries.

St. Louis Union Electric Company A. I. E. E. Section.—Following the intention, announced Feb. 24, to organize a branch section of the National Electric Light Association among the employees of the Union Electric Light & Power Company, of St. Louis, 140 men of the electrical and allied departments have already made application for membership. The first meeting of the new branch section will be held shortly, when officers will be elected.

Elevated Railway Traffic in Chicago.—According to a statement by the Union Elevated Loop Railroad Company in making its annual payment to the city of Chicago, the average number of passengers carried daily on the elevated railways of Chicago during the last six months was 419,897. The Loop Company is allowed ½ cent for every passenger carried over any of the four elevated railways except passengers using the Congress Street terminal of the South Side Elevated Railroad.

Fort Wayne A. I. E. E. Section.—The regular meeting of the Fort Wayne Section was held on the evening of Thursday, March 10, at which Mr. O. Cooper, engineer in charge of the switchboard department of the Fort Wayne Electric Works, presented a paper entitled "Three-Wire Switchboards." The paper was almost entirely upon the subjects of design and control and the matter of specifications issued upon this subject by consulting engineers.

The Next Colorado Convention.—The executive committee of the Colorado Electric Light, Power & Railway Association held a meeting at Denver March 10 and decided to hold the next convention of that association at Hotel Colorado, Glenwood Springs, Colo., Sept. 21, 22 and 23, 1910. This decision of the executive committee was reached after getting the preferences of a large number of the members of the association as to the place of meeting. Mr. J. C. Lawler, of Colorado Springs, is the secretary of the association.

Royalties for Edison.—It is reported that the royalties paid to Mr. Thomas A. Edison by eight American and three European manufacturers of moving-picture films amount to about $7,000 per week. The estimate is based on a total output of 1,400,000 ft. of film per week, upon which the royalty rate is ½ cent per foot. The validity of the Edison patents, which had been the subject of litigation for 11 years, was affirmed in a decision by Judge Noyes, of the United States Circuit Court, rendered on March 8.

Boston Subway for New Haven Railroad.—Mr. Timothy E. Byrnes, vice-president of the New York, New Haven & Hartford Railroad Company, has placed before the Massachusetts Legislature the plans of the company for a $16,000,000 tunnel between the North and South stations in Boston. He stated that the electrification would be carried along with the construction work, and in three years the tunnel could be built and by that time a part of the suburban service out of Boston would be electrically operated.

Telegraph Plans for Venezuela.—According to Consul Manning of La Guayra, the Government of Venezuela has arranged for international telegraphic communication between Colombia, Ecuador, Peru and Venezuela. It is also stated that the Government of Venezuela, in connection with the Compañia Anonima de Navegacion Fluvial y Costanera de Venezuela, has decided to establish wireless stations of the De Forest system at Pampatar, Coche and Araya, Margarita Island, and on board the steamer *Venezuela* of the company.

Electric Service at Cascade Tunnel.—On account of an avalanche of snow, estimated to be one mile in length, carrying with it two Great Northern trains with three steam locomotives and four electric locomotives, along the west slope of the Cascade tunnel, on March 1, it is believed that the electric service in the tunnel cannot be resumed in less than three months. Even at this late date the extent of the damage to the electrical equipment has not been determined, but all of the electric locomotives were swept from the tracks to the canyon below.

Wireless Telegraph Engineers.—The annual meeting of the Society of Wireless Telegraph Engineers was held in Boston on Monday, Feb. 28. The following men were elected to the offices indicated: Dr. Lee deForest, president; Mr. John Stone, vice-president; Mr. V. F. Greaves, treasurer; Mr. E. D. Forbes, secretary; Messrs. W. H. Bathrick, J. H. Campbell and E. B. Moore, managers. A paper by Dr. Louis Cohen, entitled "Coupled Circuits in Which the Secondary Has Distributed Inductance and Capacity," was discussed by Mr. O. C. Roos.

Depreciation.—A recent publication of the American Street and Interurban Railway Association contains a paper entitled "The Treatment of Depreciation," by Mr. Frank R. Ford, which discusses the divergence in the rulings of the four recognized authorities, namely, the Interstate Commerce Commission, the Bureau of Internal Revenue and the Public Service Commissions of New York and Wisconsin. The author remarked that the rulings of the public service commissions that obsolescence shall be charged to income has already had the effect of increasing largely the useful life of all physical property and of delaying changes in the art.

Traffic in Chicago Freight Tunnels.—An interesting statement of the amount of business done by the Illinois Tunnel Company is afforded by its report to the city for 1909 as a basis on which to compute the compensation due the city. The company reports that its business for the year amounted to $445,105.18. On this amount the city receives 5 per cent, but as the property is in the hands of receivers, the money will not be paid until later. The notice sent to the city comptroller gives the value of the traffic by months, and it is shown that the receipts for the last six months of 1909 were much larger than for the first six months. The poorest business of the year was done in February, 1909, when the receipts were $16,085.21. The best month was October, when the receipts amounted to $68,983.51.

Measurements of Resistance and Electromotive Force.—Circular No. 21 of the Bureau of Standards, Washington, D. C., gives schedules of fees and detailed descriptions of tests for making precision measurements of resistance and e.m.f. Much valuable data are given concerning reference and working standards and the accuracy required for various classes of work. Since the organization of the Bureau all resistance measurements have been referred to a considerable number of 1-ohm and 0.1-ohm precision standards of Reichsanstalt design verified from time to time at that institution. Beginning on July 1, 1909, these were replaced by standards, embodying the same principles of construction, but sealed to eliminate the influence of atmospheric humidity. The standard of e.m.f. is a number of Weston normal cells.

Fast Electric Elevator Travel.—One of the express elevators in the Board of Trade Building, Chicago, is said to be the fastest electric elevator in the world. Mr. John W. Mabbs, chief engineer of the building and the designer of the elevator, is responsible for the statement. The rate of travel is 570 ft. a minute. The driving motor is itself the counterweight for the car.

A. I. E. E. Nominations.—As a result of the official canvass of the membership made by the board of directors of the American Institute of Electrical Engineers, the following nominations have been made for the offices indicated: Prof. Dugald C. Jackson, president; Messrs. P. H. Thomas, H. W. Buck and Morgan Brooks, vice-presidents; Messrs. H. H. Barnes, C. E. Scribner, W. S. Rugg and R. G. Black, managers; Mr. George A. Hamilton, treasurer, and Mr. Ralph W. Pope, secretary.

Electrically Lighted Hearse.—For the purpose of conveying a whole funeral party with the casket and remains in a single vehicle, Undertaker Fred Hulberg, of New York, has designed and constructed in his own carriage shop a combination automobile hearse and funeral coach, 16 ft. in length. The vehicle is lighted throughout by electric lamps. There are two dome lamps controlled by push-buttons; also tail lamps and front lamps similarly controlled from the dashboard. Furthermore, there is a telephone on the inside by which to speak to the chauffeur. An electric signal apparatus is also provided.

Russian Electric Railway Exposition.—An international exposition of "Electricity as Applied to Railway Service" will be held in St. Petersburg during the month of August. It is stated that through this exposition the Russian Government desires to fix its ideas concerning the electrification of Russian railways. A special trial track has been provided, on which all exhibits of electric railway motor cars will be tested on the level and with varying grades and loads. The exhibitors will be permitted to sell an exhibit during the display or at the conclusion of the exposition. The president of the organizing committee is General Sitenko, 24 Sadovaja, St. Petersburg, to whom inquiries in English may be addressed by intending exhibitors.

Electromagnet for Lifting Sunken Iron.—An electromagnet has been built by the Cutler-Hammer Manufacturing Company for the United States Steel Company for use in rescuing iron cargoes from the bed of the Mississippi River. The magnet, which is 3½ ft. in diameter and weighs 3000 lb., has been placed in service near New Orleans for raising a barge load of kegged nails. At each lift five or six kegs, each weighing 200 lb., were raised intact. None of the material was lost, while if a dredge had been used the kegs would have broken open and the loss would have been serious. The kegs were raised from a depth of 70 ft. The next task for the magnet will be the raising of a load of steel strips used in fastening cotton bales which was sunk near Natchez. The third task will be lifting a load of woven wire sunk near Pittsburgh.

Fort Wayne Business Men Inspect Mishawaka Street Lighting.—A large party of Fort Wayne, Ind., business men inspected the special street lighting of Mishawaka, Ind., on March 9. The general effect of the Mishawaka illumination is pleasing. There are seven 14-ft. posts to a block, and the special lighting covers 14 city blocks. The posts are spaced 50 ft. apart, and each one supports three 40-watt tungsten lamps in spherical frosted globes, except the street-corner posts, which have five lamps instead of three. There has been some complaint of the fragility of the filaments, and it is said that the jar of passing street cars or other street traffic occasionally puts a lamp out of commission. Fort Wayne merchants are contemplating a special street-lighting installation, but some of them favor arc lamps.

Do Telegraphers Get in a Rut?—Under the heading "From the Telegrapher's Side," the Chicago *Sunday Tribune* of recent date printed a communication signed by Mr. L. K. Davis, 319 Englewood Avenue, Chicago, which is of some interest. The writer, basing his remarks on the possibility that the telephone may supersede the telegraph for transmitting train orders, says that telegraph operators, as a rule, are quite intelligent and faithful, but poorly paid for their services and doing work that is seldom appreciated by their superior officers. "They get in a rut," says Mr. Davis, "and have to be yanked out before they will quit the business. I got out of it over 20 years ago and would be glad to induce 25,000 or more operators to quit the key, go to farming or anything else that is honorable, and have some real happiness."

Curious Ideas About Electricity.—Every little while somebody bobs up in the daily papers to express the idea that industrial uses of electricity have some effect on the meteorological conditions. Thus, a recent contributor to the Chicago *Daily News*, signing the name C. A. Clark, believes that the derangement of our climate and seasons is due to the vast amount of electricity that is used. It will continue, according to Mr. Clark, so long as the present conditions exist. "I have lived in this city nearly 17 years," he adds, "but I saw more lightning in one night in Jefferson County, Indiana, than in all the time I have lived in Chicago. I think this is due to the use of electricity. I attribute the recent cold winter to the position of the moon. It rises many degrees north of east and sets a number of degrees north of west. I have noticed this carefully for the last 45 years and it never has failed."

Generating Station for Los Angeles Lighting Company.—According to an announcement made at the annual banquet of the Long Beach (Cal.) Chamber of Commerce, on March 3, a large steam generating plant is to be built at Long Beach by the Southern California Edison Company, of Los Angeles, very soon. A site comprising five acres of land has been secured, it is said, at the mouth of the San Gabriel River just south of the ocean entrance to the Long Beach Harbor. The plant will be a steam-generating station, and it is hoped to have it in operation within a year. From it electricity will be distributed to the beach towns in the vicinity including Long Beach, Redondo, Naples, Venice, Ocean Park, Santa Monica, San Pedro and Wilmington. It is reported that the initial installation will have a rating of 30,000 hp, but that when completed in accordance with the ultimate design, the rating will be 100,000 hp, and the plant will have cost, possibly, between $6,000,000 and $8,000,000.

Space Club of Chicago.—Mr. J. M. Wakeman, the retiring first vice-president of the McGraw Publishing Company, of New York, was the guest of the Space Club at luncheon on March 7, and he addressed the members briefly. Mr. Wakeman spoke of the marked improvement in the methods of conducting advertising business in recent years and pointed out that the advertising solicitor, with his expert knowledge, is now a real and trusted friend of the advertiser, advising the latter in good faith as to the proper method of securing profitable publicity in the required direction and in the manner and to the amount indicated by the necessities of the individual advertising proposition under consideration. Good fellowship and a fair mutual understanding now obtain between the advertising men of the different technical and trade papers in the Chicago field. The Space Club has done a great deal to bring this situation about, and if it had done nothing else, said Mr. Wakeman in conclusion, it would have amply justified its existence. Mr. Wakeman interspersed his talk with some well-told stories, and his remarks were much appreciated by the members of the club. Mr. B. B. Ayers, publicity manager of the American Steel & Wire Company, discussed methods of overcoming the inertia of possible buyers in, say, the agricultural field by the power of advertising. Both Mr. Wakeman and Mr. Ayers received the thanks of the club for their addresses.

Sixty-Cent Gas at Indianapolis.—Gas at 60 cents per 1000 cu. ft. has been manufactured and sold at a profit at Indianapolis, Ind., according to the annual report of the Citizens' Gas Company, of that place, which showed a net surplus of $21,189 on Dec. 31, 1909.

Natural Gas for St. Louis.—According to reports from St. Louis natural gas is to be piped to that city through 442 miles of 20-in. pipe from the Caddo fields in Louisiana. The gas, which will be sold at from 45 to 55 cents per 1000 cu. ft., will be used for generating electricity and for general distribution.

American Peat Society.—The second volume of the *Journal* of American Peat Society has been completed under the editorship of Mr. Charles A. Davis, 1733 Columbia Road, Washington, D. C. In addition to printing the papers presented before the several branches of the society, the *Journal* contains original articles and a complete review of the field in the form of abstracts from periodicals, notes on current development, etc.

Beautifying Electrification.—On account of the substitution of electric for steam locomotives in its Park Avenue tunnel, in New York City, the New York Central & Hudson River Railroad Company has announced its intention of roofing over the whole roadway between Forty-fifth and Fiftieth streets and erecting imposing semipublic buildings along the route. Sites have been suggested for a new Metropolitan Opera House, the National Academy of Design and other notable institutions.

Electrochemistry.—A meeting of the New York Section of the American Electrochemical Society will be held at the Chemists' Club on March 16 at 8:15 p. m. Dr. L. H. Baekeland will speak briefly on "The Eighth International Congress of Applied Chemistry" to be held in the United States in 1912. Dr. Fritz Zimmermann will present a paper on an experimental study of "The Decomposition of Carbon Monoxide in the Presence of Metallic Catalytic Agents." Dr. Reston Stevenson will present a paper on "Chemical Reactions at Electrodes," which will give a suggestive, critical summary of our present knowledge on this subject.

Tungsten Lamps and Gas Engines.—Operators of plants using gas-engine drive have recently been forced to awake to the fact that better speed regulation is necessary with tungsten lamps than with the old carbon-filament lamps. Fluctuations which were permissible with the gas-engine drive where nothing but carbon lamps were used are now becoming annoying where tungsten lamps are extensively used. The reason for this, of course, is the smaller heat inertia of the tungsten filament. The tungsten filament being of much smaller cross-section than the carbon filament the fluctuations in voltage caused by the slight fluctuations in the angular velocity of the gas engine frequently make an annoying flicker. It is quite evident that heavier gas-engine flywheels must be provided for electric lighting purposes than in the past.

Increase in Subway Travel.—According to a recent report of the Public Service Commission, the New York subway in December carried nearly 2,000,000 more passengers than during the previous high record month, October, when the Hudson-Fulton celebration rush was on. The increase in the number of subway passengers over December, 1908, was 2,688,724, while it was nearly 5,000,000 over September, 1909, the figures being: December, 1908, 22,712,358; September, 1909, 20,796,207; October, 23,489,467; November, 23,193,014; December, 25,401,082. The great increase in subway traffic does not mean that the other lines operating in Greater New York experienced a decrease, for the total number of passengers carried in December, 1909, was 128,881,160, as compared with 118,789,113 in 1908. The transportation revenue of the various companies for the month was $6,418,463.92 and the total revenue $6,671,947.29.

Pennsylvania State College Electrical Course.—During the past year the Pennsylvania State College opened two new laboratories, which are now being equipped. Among new equipment are two 2300-volt, three-phase, 40-hp synchronous machines; a new three-phase, 15-kw alternator; a motor-generator set, and an interpole motor. In addition, a laboratory of standards for calibration work is nearing completion. The equipment of the telephone laboratory has been supplemented by magneto and common-battery systems and a complete plant for demonstrating the latest developments in automatic telephone service. The junior and senior students enrolled this year is nearly twice the enrollment of last year, and the demand for electrical graduates bids fair far to exceed the supply, which testifies in no uncertain terms not only to appreciation on the part of the manufacturing interests, but to a growth for the college that is entirely a healthy one.

Colorado Water-Powers.—Mr. J. W. Kelley, representative of the Moffat Road, gave an interesting talk on one phase of the Government water-power conservation question at a meeting on March 3 of the Colorado Electric Club. Mr. Kelley quoted the State constitution as accepted by the United States Government, together with the original State charter, as confirming his contention that the State has been conceded full rights to dispose of its water-powers within its boundaries unrestricted in any way by Federal Government or otherwise. Mr. Kelley's further arguments were to the effect that monopoly, while practically impossible, would be much less liable to follow from the disposition of water-power rights by the State than by the Federal Government. Also, that the present policy was holding back the right of use of over 1,000,000 hp in the streams of Colorado which would otherwise be developed for manufacturing, transportation and the like. Mr. Kelley was tendered a vote of thanks for his presentation of the question, which was considered the best yet given on the subject in Colorado.

Elevated Railway Commission in Chicago.—The elevated railway commission of Chicago, formed, as announced recently in these columns, to endeavor to formulate plans to relieve the congestion on the Union Loop, has held several conferences. It is probable that the solution offered will be the through-routing of trains, with a single fare carrying a passenger through the central business district, transfer stations being located just beyond this area. It is said that the Northwestern and Oak Park elevated railways are willing to accept unrestricted through-routing, but the other companies are believed to favor limiting the through routes to a zone bounded by, say, Division Street or North Avenue on the north, Center Avenue or Halsted Street on the west and Eighteenth Street on the south. However, in return for establishing a through-route zone, the companies ask certain concesssions, such as the lengthening of loop platforms and other favors. The representatives of the various companies at the conferences are the same as foreshadowed in these columns in the issue of March 3, except that the engineering representative of the Northwestern Elevated Railroad Company is Mr. C. F. Uebelacker, of Ford, Bacon & Davis, and the engineering representative of the Chicago & Oak Park Elevated Railroad Company is Mr. E. C. Noe, general superintendent of that company, also general manager of the Northwestern Company. Mr. Bion J. Arnold, Mr. George Weston and Mr. R. C. St. John represent the city at the conferences. "The heads of the elevated lines indicate a desire to give the public all they can in the way of better service and accommodations," said Mr. George Weston after one of the meetings. "There has been no definite plan agreed upon, but we have started to work for results. The universal transfer, as a necessity, will depend upon the solution of other features first."

MERCHANTS HEAT AND LIGHT COMPANY.

Application of the Steam Turbine for Lighting and Exhaust Steam Heating at Indianapolis, Ind.

WHEN in 1902 members of the Merchants' Association of Indianapolis, Ind., erected a small station at New Jersey and Pearl Streets in an attempt to mitigate the smoke nuisance and to supply their own needs for light and heat, they never felt that the system would become more than a "family affair" and that electricity would ever be more than a by-product. In this they were mistaken, however, for with expansion forced upon them it soon became necessary to double the generating capacity of the station. Even then the business increased so rapidly and steadily that the management had to cast about for a new site; one that would permit of ample expansion in years to come and be so located with reference to fuel and water supply that economical generation became a feature. Moreover, because of the steam-heating load, the choice of sites was necessarily limited to those within a very prescribed area contiguous to the downtown district.

The new station is erected on Washington Avenue, Market and Geisendorff Streets on property formerly held by the Chandler & Taylor Company, and is within four blocks of the State House and almost within view of the downtown district. Eventually this building will house the turbo-generators used in the older station. There are three of these units, built by the Westinghouse company, which were operated non-condensing against the back pressure of the heating load. Two of these machines are now being redesigned to operate condensing and one is still running in the old station. The units at present installed in the new station were built by the Allis-Chalmers Company and are designed to operate non-condensing against a back pressure of 8 lb.; the steam consumption under these conditions being 40 lb. per kw-hour.

The engineering and construction of the new plant, as well as that for the extension of the heating and electrical distribution systems, were entrusted to Messrs. J. G. White & Company, of New York. The station itself is of brick and iron construction with foundations of mass concrete and in its design care was taken to make the coal-handling arrangements entirely mechanical. Two standard gage tracks run parallel to the boiler-room and at least five loaded cars can be accommodated at the same time. At the end of the tracks is an electric friction windlass so that as the cars are emptied they may be removed and loaded cars brought over the coal hopper. From the hopper the fuel is delivered to an electrically-driven coal crusher or, in the case of slack coal which does not need to be crushed, by-passed around the crusher to a belt conveyor which delivers it into a bucket conveyor. The latter hoists the coal to the top of the power house, whence it is transmitted by means of belt conveyors to the coal pocket. The belt conveyor over the bunker is provided with trippers enabling the coal to be dumped automatically in any part of the bin selected by the operating force. Cast-iron chutes serve to guide the coal from the bunkers to the stokers. The former are fitted with cylindrical valves to regulate the supply of coal to the stoker hoppers.

The tracks at the station connect with a spur from the Big Four Railroad, and to provide for contingencies, storage is provided for 5000 tons of coal outside the station. The fuel is taken from the cars by an electric locomotive crane which is also pressed into service to feed the stored fuel into the track hopper over the crusher when required. The conveying system was built by the Link Belt Company and the coal crusher by the Mead-Morrison Manufacturing Company. The ashes are dumped directly from the stokers into an ash hopper provided with cast-iron grates. From these the ashes are removed in ash cars to a hopper over the bucket conveyor, which in turn hoists the ashes into an overhead bunker in the outside wall of the boiler-room, whence they are delivered by chutes to wagons or cars for distribution. At present the ashes are used for filling-in purposes.

The boiler-room is designed for six 500-hp and four 612-hp

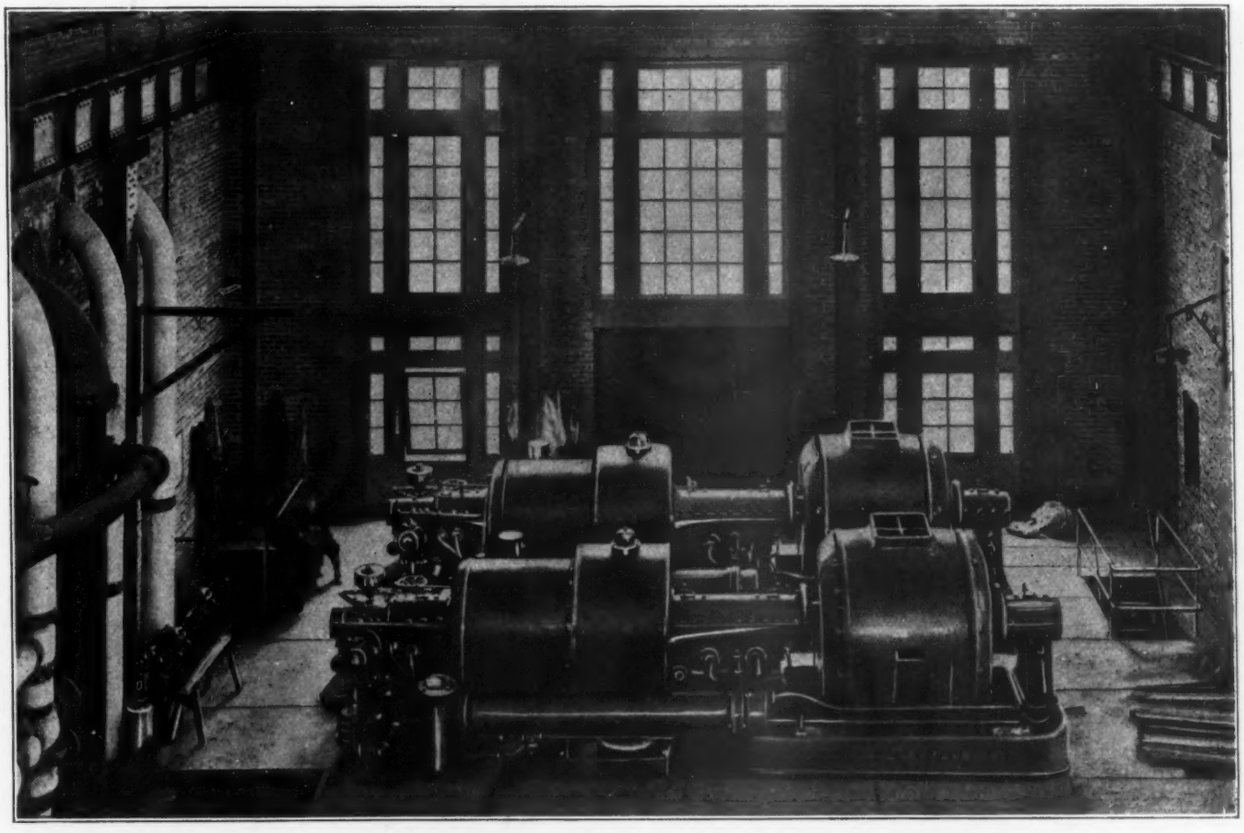


Fig. 1.—Non-Condensing Turbines for Steam Heating Load of Merchants Heat and Light Company.

Stirling water tube boilers fitted with Roney stokers, the latter boilers being taken from the old station and retubed prior to their installation. As shown in Fig. 3 the room has been designed to give ample light and ventilation under all conditions of weather. In addition to the usual windows, skylights have been provided in the roof, and louvres are installed for ventilation. Easy access is provided to the tops of the boilers, main piping, coal and ash bunkers by structural steel stairways and ladders. Space is provided for an additional 1000 hp in boiler capacity. At the end of each row of boilers and outside

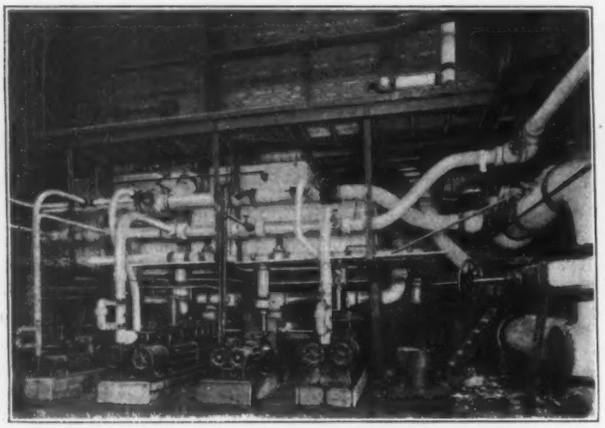


Fig. 2.—Heaters, Feed Pumps and House Pumps.

the building are 200 ft. radial brick stacks 10.5 ft. in internal diameter. An underground tunnel leads to each of these so that soot shoveled from the stacks is carried down an inclined runway in cars from the tunnel into the boiler-room basement and dumped into the bucket conveyor, whence it is carried to the ash bunker.

The generator room is designed for 4500 kw of steam turbines, with space provided for one 1000-kw and one 3000-kw unit additional. The high-pressure turbines which operate on the heating system are placed at the southern end of the build-

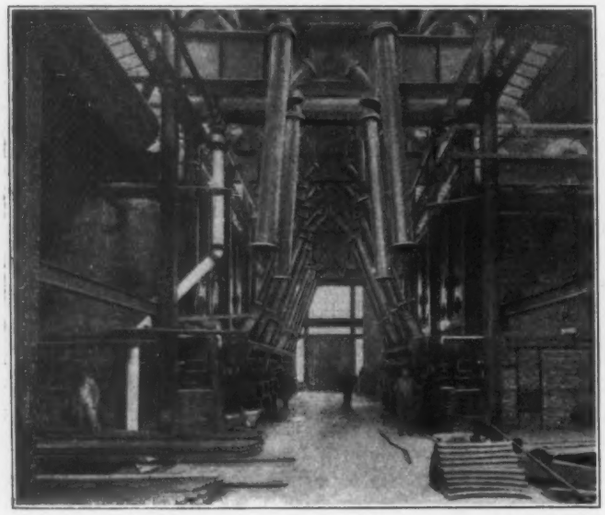


Fig. 3.—Firing Aisle, Boiler Room.

ing, as shown in Fig. 1, and the three turbines, which are being rebladed and arranged for operating condensing, will be located at the north end of the building, with a pump pit between. The former turbines are Allis-Chalmers, three-phase, 2300-volt, 60-cycle sets rated at 1000 kw each, and the latter are Westinghouse sets of similar output rated at 750 kw each. When the plant is completed the arrangement will be to operate the Allis-Chalmers units during the winter season when the exhaust can be used for heating purposes; and the Westinghouse units during the rest of the year. Excitation for the turbine sets is furnished by two engine-driven exciters.

The condensers for the Westinghouse units will be of the International Steam Pump Company's surface type, each machine having a rotative dry vacuum pump, a Fleming engine-driven centrifugal pump for circulating water and a turbine-driven hot-well pump to return the water of condensation to the feed-water heaters, which are of the Cochrane type. Water for the condensers flows by gravity from the Indianapolis Water Company's canal to the centrifugal pumps, and after

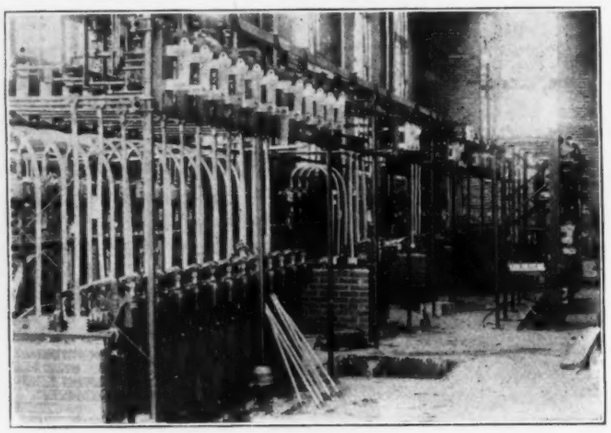


Fig. 4.—View of Switch Gear on Operating Gallery.

passing through the condensers is returned by pressure into the canal, which is 250 ft. from the pump. Inasmuch as the water company uses the water in the canal to operate hydraulic turbines at one of the pumping stations, it was necessary for the power company to agree to pump the water back into the canal again. The intake and discharge arrangement at the canal for the condensing conduits is such that the incoming supply for the condensers is the more distant from the flume supplying the water to the hydraulic turbines of the water company, and the discharge from the condenser conduits is

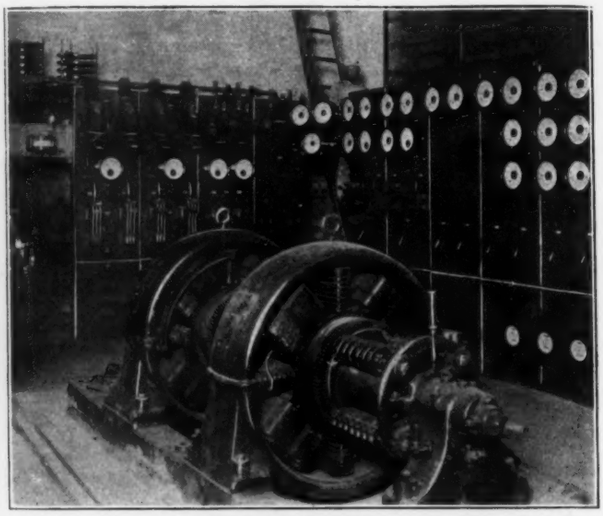


Fig. 5.—Balancing Set and Switchboard, Substation No. 1.

located so that the warm water flows directly into this flume. This assures a positive circulation of water in the canal and prevents the warm water from being returned into the intake pipe for the condensers.

Because of the impurities in the water, the feed-water heaters are set as water-purifying devices, as well as for heaters of the feed water. The water needed for the boilers over and above that obtained from the condensers, is automatically treated chemically before it is delivered to the heaters. Ex-

haust steam from all the auxiliaries in the station is also carried to the feed-water heaters and raises the temperature to about 206 deg., at which temperature, and with the chemical compound supplied, the water is purified sufficiently for boiler purposes. A special arrangement is used whereby the heaters, although located in the turbine-room, may be thoroughly washed and cleaned from the boiler-room side; a copper and lead flashing having been placed around the heaters so that the water for cleansing cannot under any conditions enter the turbine-room. Immediately in front of the heaters in the boiler-room operating floor and extending the width of the heaters, a sump has been provided and as the heaters are cleansed the deposits in them are washed into this sump and flushed into the sewer through two large drain pipes leading from the sump.

The switchboard is equipped with remote-control switches which operate the high-tension oil switches. The latter are located on the operating gallery and, therefore, none of the wiring is concealed and is easy of access for investigations. The busbars are carried on standard pipe supports about 8 ft. above the floor and 5 ft. above the oil switches. All of the buses and switches are in view of the operator, so that it is not necessary for the operator to leave his position on the switchboard gallery under operating conditions. The distribution system between the power house and the substations is laid in underground tile conduit encased in a cover of concrete. Manholes are provided at frequent intervals to allow for inspections.

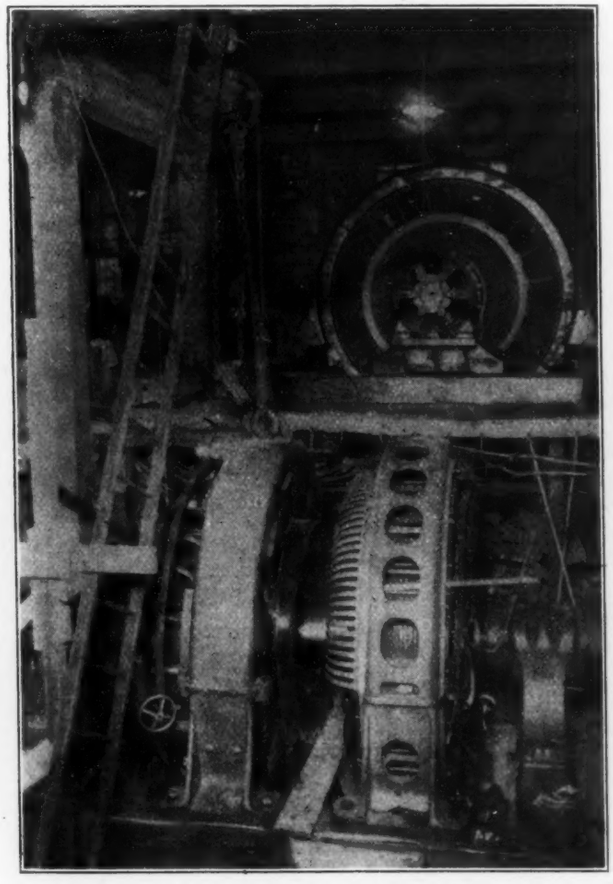


Fig. 6.—Erection of Motor-Generator Set, Substation No. 1.

Two substations are provided; one east of Illinois Street on Pearl Street and one northwest of Monument Square between Delaware and New York Streets. In the first substation are two 1000-kw motor-generator sets, with exciters, balancer sets, etc.; and in the second are two rotary converter sets with transformers, switch gear, etc. In substation No. 1 it was necessary to install the large motor-generator sets while the old equipment of 500-kw rotaries, now in the other substation, were operating. There was not sufficient room on the floor for the large 1000-kw motor-generator sets and rather than tear down the whole building a basement was dug and the motor-generators placed there. As soon as these were started

Fig. 7.—Substation No. 2.—Complete Station Viewed from Street Floor.

the floor above, as shown in Fig. 6, was removed and the appearance of the substation now is given in Fig. 8. The placing of these units while the other apparatus was in service constituted one of the most difficult tasks in the reconstruction work, as Fig. 6 would indicate.

Steam for heating is distributed from the new station through a 30-in. main which connects on Senate Avenue with a 24-in. and a 20-in. main. The latter mains feed the present distributing system of the Merchants' company. Ample room is allowed around the heating mains in the conduits to permit of easy repairs without taking the pipe out of the ground, unless the pipe has been destroyed. Expansion joints, etc., are readily

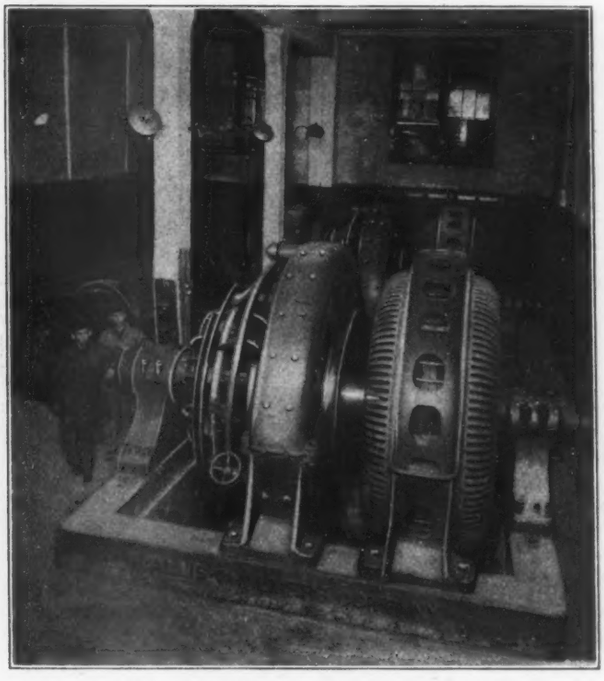


Fig. 8.—Substation No. 1, as Reconstructed.

reached through the manhole conduits. In order to provide for expansion in the mains special joints with brass sleeves have been provided and these have been placed at frequent intervals to allow for uniform expansion due to heating and for unequal expansion due to turning steam into cold mains; for if the mains are cold when the steam is fed into them, it is evident that the tops of the pipes will become heated and expand before the bottom of the mains.

All the pipe used in this work is of riveted steel plate of

heavy design with special flanges. The expansion joints are of cast iron, except in the slip sleeves, which are of carefully machined brass. Each expansion joint is placed in a manhole and provided with a low-pressure trap. The pipe itself is supported in the conduit on a pipe roll carried on a cast-iron support. Alternate layers of asbestos and mineral wool are used for insulation. At frequent intervals vertical nozzles have been provided for service connections and such as are not used are cut off by means of blank flanges. Corrugated copper gaskets are used for making joints and all 90 deg. bends have been replaced with two 45 deg. bends in order to eliminate friction as far as possible.

THE PALMER PHYSICAL LABORATORY.

Electrical Equipment of the Building Devoted to the Use of the Departments of Physics and Electrical Engineering at Princeton University.

By Howard McClenahan.

THE Palmer Physical Laboratory of Princeton University was erected by the generosity of S. S. Palmer, Esq., to meet the growing needs of the Departments of Physics and Electrical Engineering. The formal opening of the building was held in October, 1909. It is the purpose of this article to describe only the electrical equipment of the laboratory, and the description of the system may be conveniently arranged under four heads—illumination, motor equipment, experimentation and signaling.

Fig. 1—Large Lecture Room.

ILLUMINATION.

Tungsten and Gem lamps are used throughout and a severely plain style of fixtures and the Holophane globes have been adopted. Figs. 1 and 2 show the fixtures and their distribution. Such an abundance of light sources has been provided that a surprisingly uniform general illumination is produced. At the same time the circuits are so subdivided that patches of illumination may be furnished for students working in scattered portions of a laboratory.

In addition to this, a special lighting circuit is run in a moulding on the ceilings of all private and research rooms, and of all laboratories. This moulding is placed 18 in. from the side walls and permits the attachment of drop cords at any place along the walls and over the wall tables, for lighting up galvanometer scales and similar apparatus.

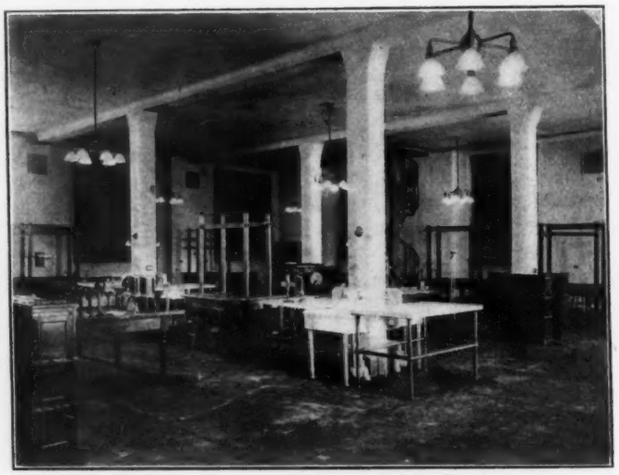


Fig. 2—Freshman Laboratory.

MOTOR EQUIPMENT.

Electricity is supplied to the building from the central plant of the University Power Company; 220-volt, two-phase for motors, and both phases at 110 volts for lamps. As it is not feasible to transmit direct currents from the power plant, a 22-kw motor-generator set has been installed for supplying the direct currents required by the battery-service, and for the experimental work of the two departments. The generator is wound for 115 volts. The additional and variable voltage demanded in the charging of the 60-cell batteries is obtained from a 5-kw booster set, run from the motor-generator set in the usual manner. The motor of the booster is run directly from the generator of the motor-generator set, and at constant speed. The field of the booster generator is excited from a "three-point, across the line" resistance, a species of a

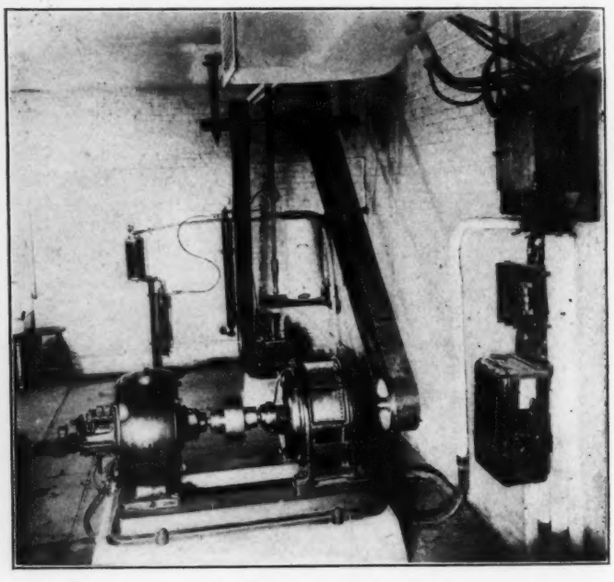


Fig. 3—Motor-Generator Set and Liquid Air Plant.

potentiometer connection. By this device a variation of voltage from 0 to 70 volts, in ½-volt steps, is made available. By this combination of booster and motor-generator, current at 115 volts is supplied to all parts of the laboratory for experimentation and motor service, while at the same time, one

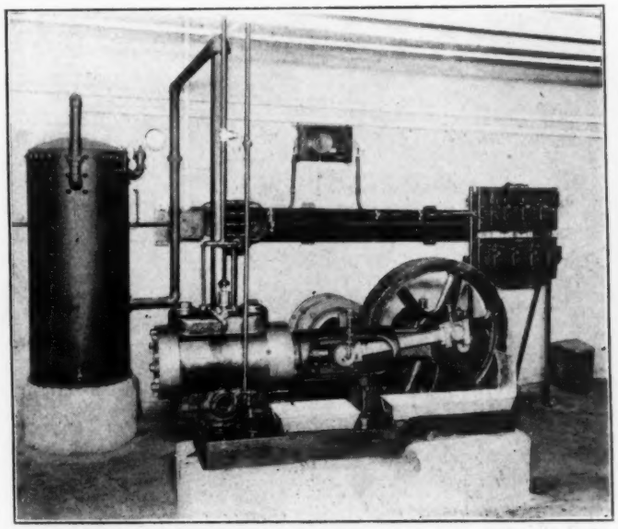


Fig. 4.—Air Compressor and Electric Control.

or all of the batteries may be charged at the proper voltage. By reversal of the booster generator field, the booster can be used as a "crusher," to provide voltage as low as 45 volts for charging particular portions of the batteries separately. The motor of the motor-generator set was chosen of sufficient capacity to enable it to drive the air compressor of the liquid air plant, while doing the work of battery charging. Fig. 3

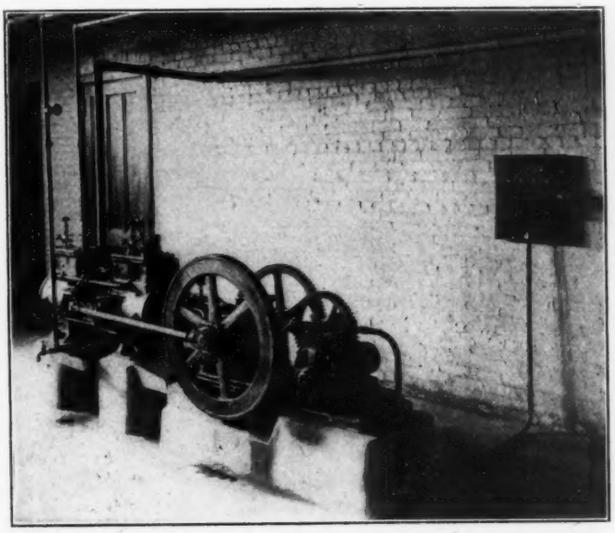


Fig. 5.—Vacuum Pump.

shows the motor belted to the countershaft of the air-compressor.

The total motor equipment of the laboratory amounts to more than 85 horsepower. The following table indicates the uses to which these motors are put:

	HP
Motor-generator set	30
Compression-pump	7½
Vacuum-pump	3
Motors in machine shop	13½
Ventilating motors	19
4-ton refrigeration plant	10
Phase and frequency-changing set	5

Fig. 4 shows the compressor and its automatic controller which supplies compressed air to all parts of the building. The pump is driven by the motor through rawhide gears. As set at this time, the pump is started by the controller when the air pressure falls to 13 lb. per square inch, and is stopped when the pressure gets up to 15 lb. per square inch. By merely shifting the two stops on the contact maker, shown high up

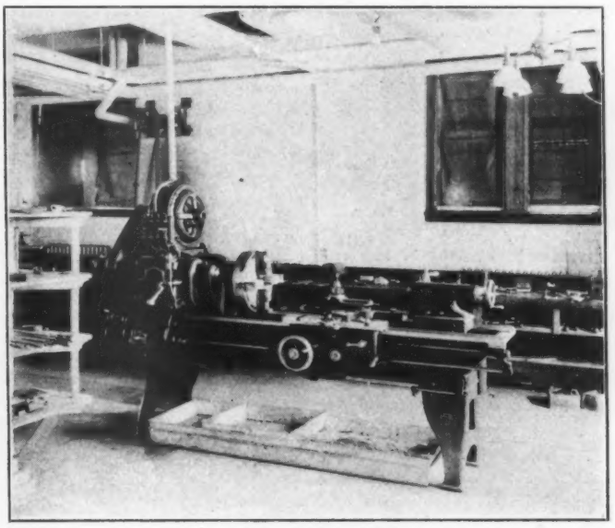


Fig. 6.—18-in. Engine Lathe and Motor.

on the wall in Fig. 4, pressure up to 75 or 100 lb. per square inch, with any desired closeness of regulation, may be provided.

Fig. 5 shows the vacuum pump, with the motor connected through rawhide gears. This pump produces a vacuum with pressure down to 0.02 in. of mercury. Like the pressure pump, it is connected to a system of pipes leading to all parts

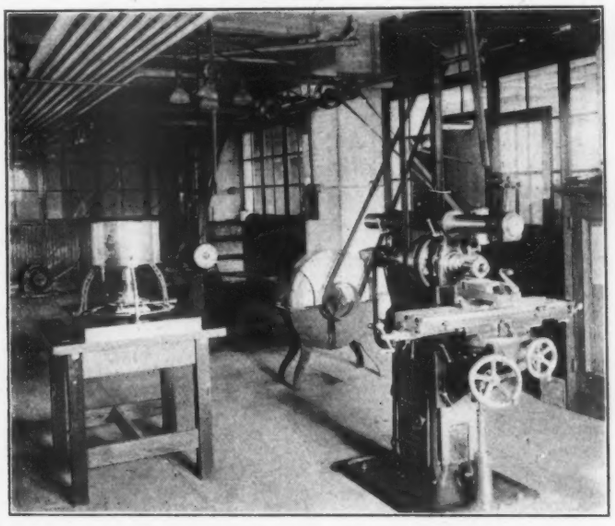


Fig. 7.—View of Main Machine Shop.

of the building. By means of these two systems, compressed air and a high vacuum can be obtained in any laboratory or research room at any time.

In laying out the main machine shop, it was desired to prevent the transmission of vibrations from the machine tools to the building. It was decided to provide the engine lathe and the heavy drill press with separate motors, while the remainder of the tools are belted to the main line of shafting. An 18-in. engine lathe with 4-hp induction motor mounted on the head stock is shown in Fig. 6, while a view of a part of the shop and the line of shafting driven by a 7½-hp motor is given in Fig. 7.

EXPERIMENTATION.

The apparatus and circuits designed to meet the requirements of experimental work form the most marked electrical feature of the laboratory. They possess an elaborateness and a flexibility which, the writer believes, is not to be found in any other building used for similar purposes.

Four batteries of 60 cells each have been installed. Two of these have a normal charging rate of 15 amp, and a capacity of 120 amp-hours, while the other two have a normal charging rate of 40 amp and a capacity of 320 amp-hours. The latter two are used generally and for any purposes, and are called the "service batteries." The first two are used exclusively for experimental work, in which rigorously constant voltages are necessary, and are known as the "research batteries." One of the service batteries has all of its cells permanently connected in series, giving approximately 120 volts at all times for small direct-current motors and other direct-current apparatus. The other service battery has its 60 cells connected in 10 groups of 6 cells each in series, giving 12 volts as the unit for it. By means of a mercury cup board all of these six sets may be thrown into series giving 120 volts and 160 amp for one hour, or into parallel, giving 12 volts and 1600 amp. for one hour, or into any series—parallel grouping. Both of the "research" batteries have all their cells connected singly to the mercury

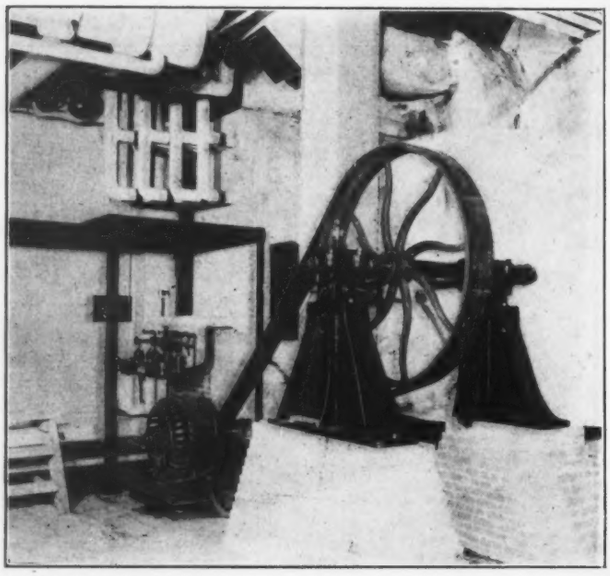


Fig. 8.—Motor-Driven Ventilating Fan.

cup board, so that the 60 cells of each may be joined in series or in multiple or in any parallel-series grouping. The four batteries can be thrown into parallel or into series with the motor-generator and booster sets. The flexibility of the system is shown when it is stated that 120 single cells can be put into multiple, giving 2 volts and a maximum current from them of 7200 amp. Or the two "research" batteries may be connected into 20 sets of six cells each, and all of these put into multiple with the 10 to 12 volt units of the service battery, offering 12 volts and a maximum current capacity of 2800 amp for one hour. Again, one may connect the four batteries and the motor-generator and the booster sets in series, supplying 660 volts and a maximum current of 60 amp. for one hour. In a word, one may secure any continuous voltage between 2 volts and 660 volts in steps of 2 volts, with a power of from 14 to 40 kilowatts.

All of the wiring in, and leading from, the two battery rooms is carried out with lead-covered wires. Whenever the lead sheath was removed, melted paraffin was forced under the sheath as far as it could be pushed and the orifice filled with paraffin. The wire was then taped and painted with an insulating paint, and then given a final coating of paraffin. Fig. 9 shows the mounting and wiring of one of the "research" batteries.

The mercury cup switchboards, which serve for the distribution of the battery currents, are mounted high up from the floor along one side of the battery rooms. The lead-covered conductors from the cells, or groups of cells, run vertically up to the ceiling, along the ceiling on porcelain cleats, and then down the wall back of the mercury cup board. The cups

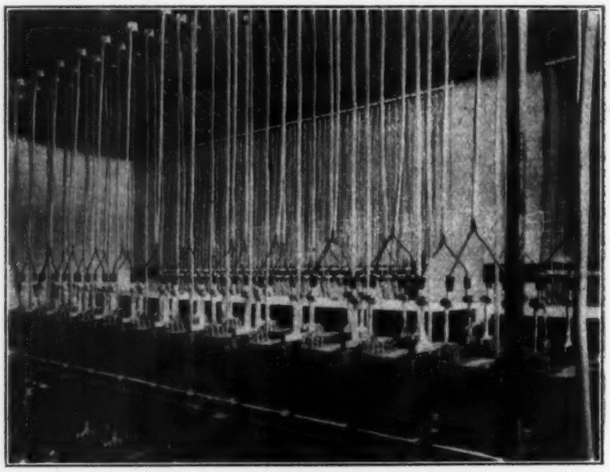


Fig. 9.—Research Battery.

are holes ½ in. in diameter and 1 in. deep, drilled in the 2-in. white marble slabs. Below a depth of 1 in. these holes are contracted to 3/16 in. and a specially-designed copper plug is sealed mercury-tight in the hole. The lower end of the plug is threaded, and provided with wing and check nuts for making the necessary connections. The conductors from the cells are connected to these plugs, and then the joint is given a heavy coating of melted paraffin to protect the metal from the action of the battery spray.

The desired series, or parallel, or series-parallel grouping of the cells is effected on these mercury cup panels. Any of the combinations of voltage and current outlined above may be made by insertion of suitable conductors in the proper cups. Yet the cups are so spaced that it is not possible to short-

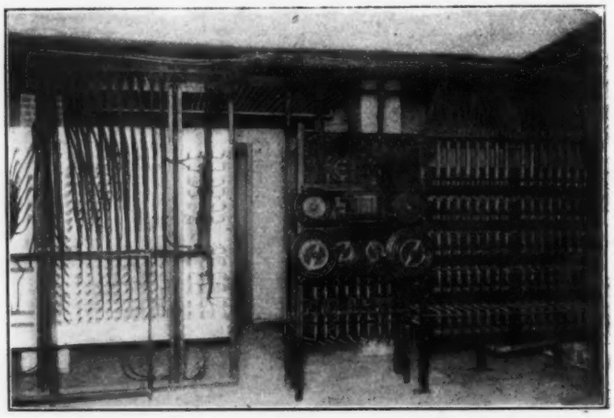


Fig. 10.—Back of Main Switchboard.

circuit a single cell, when one uses the conductors made for the board. Combinations of cells can be short-circuited only with real difficulty. After more than a year's service, the method of making connections has proven itself nearly fool-proof.

Eleven pairs of lead-covered cables lead from mercury cups on these panels to the main switchboard where, of course, they may be connected to any desired part of the laboratory. A bundle of these conductors is shown carried along the ceiling

in Fig. 10 and connected to the proper lugs on one of the battery panels.

The main board is separated into two distinct parts, as shown in Fig. 10. The service panels, for controlling the lamps and motors, are on the right in that picture, while a portion of the experimental board appears on the left. The former may be discussed with a few words. Immediately to the right of the passageway is the panel for controlling the battery charging. The attendant assures himself that the motor-generator and the booster sets are prepared for use, and then starts the former through the controller placed near the set. All further operations are carried on from the main board. The excitation of the generator is controlled, the booster is started, and one or more batteries thrown on charge

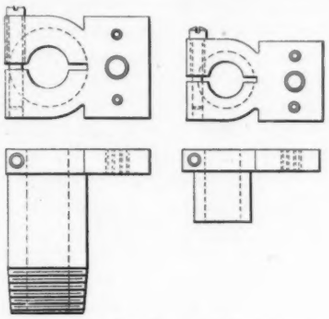


Fig. 11.—Details of Connector.

by the attendant standing before the panel mentioned. The view shows the four controlling resistances which are inserted in the battery circuits, the rheostat in the generator field and the "three-point" potentiometer resistance for the booster set. Fig. 11 shows a detail of the connection of the buses to the fuse-blocks.

The experimental board is made up of five panels, which are mounted on insulated supports, and which are separated from one another by a ½-in. air space. A good protection against grounding on the board has thus been secured. Two of the five panels are reserved for the above described conductors coming from the four storage batteries. The third panel is a supply panel and has on it the 115-volt direct-current circuit from the motor-generator set, both phases of the 110-volt alternating-current service and both phases of the 220-volt alternating-current service. The fourth panel bears the connections from the five lecture rooms and the nine student laboratories of the building, while the fifth panel is exclusively for the conductors from the private laboratories and the research rooms. All connections on the front of this board

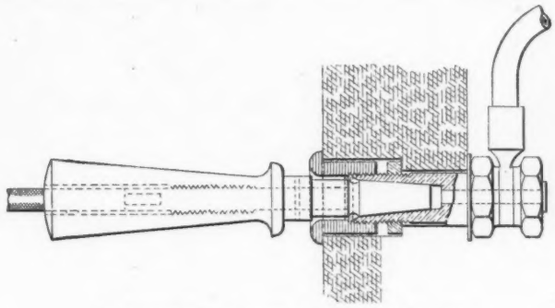


Fig. 12.—Section View of Plug and Socket.

are made by plug and socket, as on the old arc lamp boards.

Ten conductors run from this experimental board to each of the two main lecture rooms, while six conductors run to each of the smaller lecture rooms and to each of the laboratories. Of the ten conductors four can carry 125 amp; all the others carry 30 amp. The six conductor sets also carry 30 amp. The ten conductors leading to one of the large lecture halls are connected to the subsidiary panel shown in Fig. 13. This panel is mounted directly back of the lecture table within 4 or 5 ft. of the lecturer's usual position. Ten massive copper straps with sockets, run horizontally back of the 10 horizontal rows of holes. Each of these straps is cut at the middle and the two parts separated by an air gap. Thus, the three sockets to the left of any of the number discs are on one strap, the three sockets to the right are on another. The ten straps to

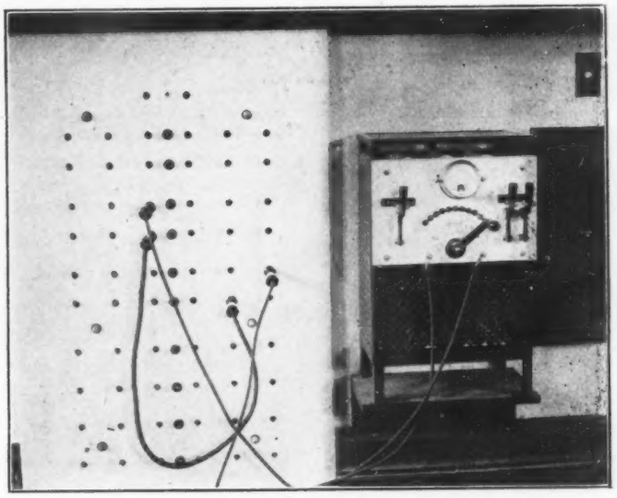


Fig. 13.—Lecture-Room Panel.

the left of the vertical central line are connected to the conductors from the main switchboard. Of the straps to the right of the median line, the six upper ones are joined to sockets on the lecture table by conductors under the floor. The four lower ones lead to floor plugs among the seats, for lantern projection. By the use of this panel, the writer has frequently had available on the lecture table at one time, 12-volt, 36-volt, 72-volt and 120-volt direct-current, and 110 and 220 volt alternating current, obtained by the shifting of one or, at most, two

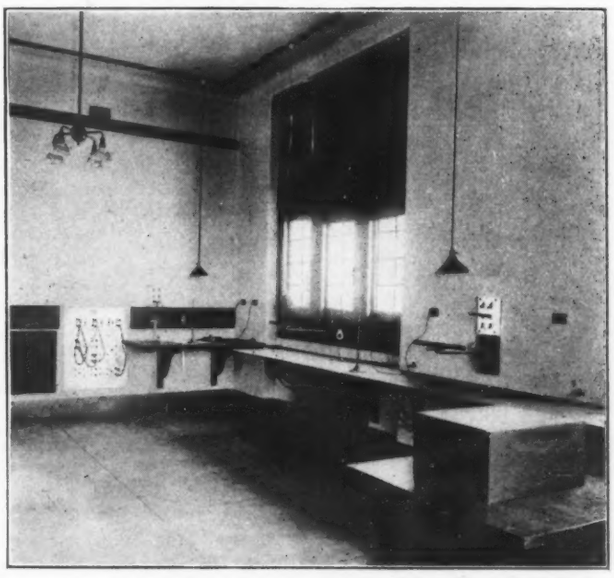


Fig. 14.—Laboratory Panel.

plugs. As shown in the figure, a tension of 120 volts is connected in series with a lantern on the table and with the controlling rheostat. An equivalent system is installed in the smaller lecture rooms and in all of the student laboratories.

At least two independent circuits lead from sockets on the main board to a small wall panel in each professor's room and in each research room, and to that room only. One is thus assured that his line will never be interfered with by some one else. In addition to the above described wiring, installed

to ensure constancy of voltage and current for experimental work, four alternating current and four direct current wall plugs are installed in every research room and laboratory. These furnish current under a pressure of 110 volts for lamps and motors, when variations of voltage are not vital.

Figs. 14 and 15 are inserted to show the experimental equipment of a typical workroom. They portray the four walls

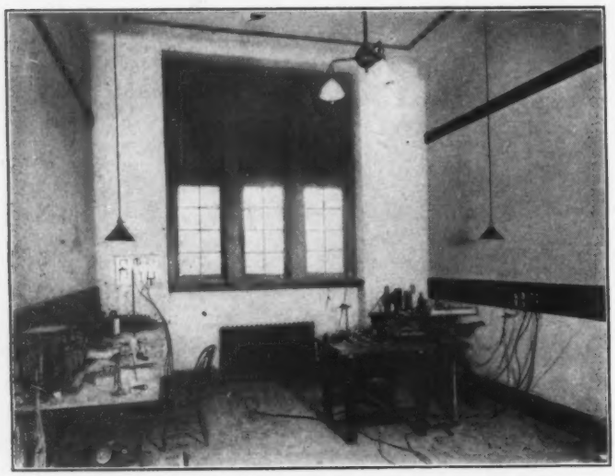


Fig. 15—Typical Workroom.

of the room, with the various items already mentioned, viz., the wall panel, with circuits leading to this room alone, eight wall sockets, the ceiling moulding for drop cords, pressure and vacuum connections, water supply and seven gas outlets. This equipment is the standard for the laboratory, and is found in every room used by advanced students or by members of the teaching staff.

SIGNAL SYSTEM.

The remaining feature of the electrical equipment is the signaling system. This includes two essentially distinct types of apparatus, telephones and signal circuits. An automatic, intercommunicating, telephone system, restricted to the laboratory, has been installed. It has sixteen instruments, placed in such central situations as the switchboard room, the machine

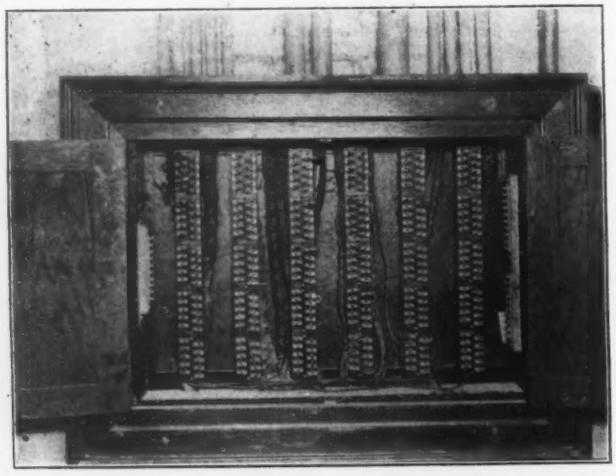


Fig. 16.—Panel of Intercommunicating Signal System.

shop, and so on. Its wiring is wholly separated from all the other wiring of the building and is run in ducts entirely separated from all others.

The interconnecting signal system has proven itself a most valuable addition to the electrical equipment. A 10-conductor cable runs from a small box, or panel, in each room to a central panel, like that shown in Fig. 16. Each of the small 10-connector units shown in this view is a duplicate of those installed in all the rooms. Of the 10 conductors from any room, two are used for the push-button system. And for some other rooms, two others are occupied by the general Bell telephones installed in the building. At least six conductors are available in every room, for connecting that room with any others, for bringing in time signals, for joining up to distant recording devices, and for similar services. As an example of the use of this system may be cited the method of testing the refrigeration plant of the laboratory. During the test run, when an effort was being made to get the lowest possible temperature, and when it was most undesirable to have an observer enter the cold rooms, a resistance thermometer in those rooms was joined through the interconnecting system to a Callender recorder, and a constant record of the temperatures was obtained.

The total cost of the electrical equipment of which a description is here attempted, amounted to nearly $45,000.

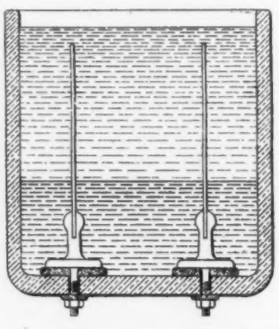
As a part of the supplemental equipment, an electrical standards room has been fitted up where potentiometers, comparators and bridges are constantly kept in condition for immediate use. The primary standards of the laboratory are reserved for use in this room, so that one can standardize his measuring instruments and resistances, without the delay of setting up apparatus, usually incident to such comparisons.

The consulting engineers for the electrical work were Messrs. Mailloux & Knox, of New York. Though much of the plan of the experimental wiring, and entire plan of the battery equipment, were suggested by members of the physics and electrical engineering departments, the remarkable success of the whole system was due to the engineers. Mr. H. J. Hardenbergh, of New York, was the architect for the laboratory.

ALUMINUM-CELL ARRESTER WITH SUBMERGED ELECTRODES.

The arrangement of submerged electrodes illustrated herewith has been devised by Mr. J. L. R. Heyden and patented on Jan. 11. Where an electrolytic cell having aluminum electrodes is used as a lightning arrester, and particularly where it is directly connected to the line so that there is a continuous flow of current through it, the aluminum electrodes or plates are corroded and gradually eaten away. The corrosive action is especially marked at the surface of the electrolyte and consequently the cell is gradually destroyed. The corrosion of the aluminum electrodes occurs in a very erratic manner; sometimes the electrodes will last a year and again will be eaten through in a few days.

According to the arrangement here shown, the electrodes are



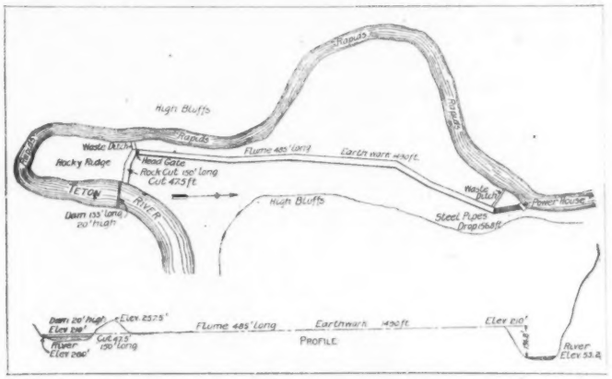
Aluminum-Cell Arrester with Submerged Electrodes.

not brought through the surface of the electrolyte, but are completely submerged therein and connection with the electrodes is made by means of terminals placed near the bottom of the vessel. The terminals are thoroughly insulated from the vessel and are surrounded with some heavy non-conducting liquid, such as carbon tetrachloride or bromoform, upon which the electrolyte floats, but with which it does not mix.

PROPOSED HYDROELECTRIC DEVELOPMENT ON THE TETON RIVER, IDAHO.

By JULIAN M. DE COSTER.

Almost all of the power plants of the West situated on mountain streams have had to contend with troublesome slush ice, but an exception is found in southeastern Idaho, where there exists at all times a long stretch of open water on the Teton River at the location of the dam of the Teton River Light & Power Company. The Teton River has its source in one of the glaciers of the famous Teton Peaks, about 1400 ft. high, and with its many tributaries drains a valley 30 miles long by 20 miles wide, not including the forest reserves situated on the surrounding mountain ridges. After irrigating the fields of grain and hay situated at an altitude of 6000 ft., and a few apple orchards in favored spots, the waters of the Teton River leave the basin through a rocky canyon, bounding over a series of rapids. Just above the three higher ones the Teton River Light & Power Company, Ltd., is working on its dam. Here for



Map of Proposed Teton River Development.

about one mile the river runs smooth on a gravelly bottom supported by solid lava, and big warm springs emptying into it keep its water open all the year around. At this point the company will excavate about 8000 cu. yd. of rock from a ditch, or cut, and use it for forming a dam which will raise the water some 20 ft. and allow it to run through the cut, the length of which is 150 ft. by about 50 ft. deep at the maximum depth.

The prism of the canal and the slopes of the cut will have to be modified somewhat from the original plans, and the banks given more slope, for what seemed to be a ledge of solid rock covered with loose boulders turns out to be, for one-half of its depth at least, a slide of rock imbedded in gravel and hardpan cement. At the end of the cut, at an angle with it, a waste ditch and a double headgate of reinforced concrete will be built, one to control the waste water, another in the power-house channel to regulate the flow of water therein. Here it was the intention of the company to build a temporary power house and with the 60-ft. fall to be had there to generate some 3000 hp. However, conditions becoming more favorable, and the necessity for electrical power increasing all the time, the company is now planning to develop at once the 18,000 hp at the end of the ditch. The market for the energy is expected to include lumber mills, paper mills, coke ovens and similar industries.

At the end of the rocky cut above mentioned a reinforced-concrete flume was to be built on the flank of the side hill, to carry the 900 cu. ft. of water per second carried by the river at its lowest stage. This amount of water increases every year, just as does the irrigation of the valley above, so that at a conservative estimate in a few years this low flow will be increased by at least one-third. This flume, in the opinion of the writer, could be profitably done away with by swinging the water more to the east and making a cut in solid ground. After running through the flume for some 485 ft. the diverted waters of the river will flow for 1500 ft. through an open canal to reach at least three steel pipes 36 in. in diameter. They will be about 200 ft. long and rest on piers laid in cement, built on the side hill. Having thus a perpendicular drop of 157 ft., the water will be able to actuate three 6000-hp turbines. At the head of the pipe line the reinforced-cement intake basin will have some three headgates as an additional help to control the waters. Moreover, the customary racks will be provided to protect the pipes against floating trash.

The outline plans for the development of this water-power were made by the late Mr. Fred W. Mitchell. Many of the details of construction and equipment have not yet been determined upon. In comparison with other hydroelectric developments, the one noted above is surely remarkable by the certainty of its water supply, to total absence of slush ice, and the very low cost of its development.

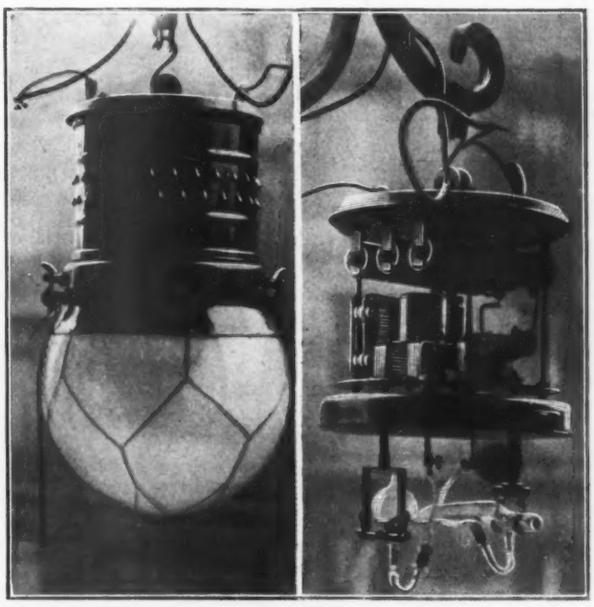
QUARTZ-TUBE, MERCURY-VAPOR LAMPS.

By WARREN H. MILLER.

Out in front of the Garage Cardinet, in Paris, hangs a lamp, brilliant as any flaming arc, giving a beautiful golden-white color, faintly tinged with green. Three hundred feet away from it one can easily read a typewritten letter, and yet, close under it, the light is still diffused, not glary and harsh with sharp inky shadows, but simply brighter.

The lamp looks like an ordinary arc, but there is no point of light distinguishable in the globe, which appears to emit its flood of light from all over its surface. When viewed through a crevice between the fingers the predominating color at once becomes yellow and one can distinguish, in the center of the globe, a horizontal bar of light, seemingly about 6 in. long.

The lamp is one of the first 50 quartz-tube, mercury-vapor lamps put in commercial service by the French Westinghouse Company, and the writer believes the lamp will prove especially serviceable. With 0.25 watt per candle specific consumption, with all the brilliance of the best flaming arcs, and yet with no renewals for electrodes, no cleaning of glassware and no delicate parts to overhaul, it appears as near ideal as anything



Figs. 1 and 2—Quartz-Tube, Mercury-Vapor Lamp.

yet offered in the field of illumination. The green color that characterized the earlier mercury-vapor lamps is almost entirely wanting, being replaced by a flood of pleasing golden-white.

Briefly stated, the operation of the lamps depends on the fact that when a mercury-vapor arc is shortened to from 3 in. to 5 in., and run at an e.m.f. of 110 volts and 220 volts respectively, it is heated to a far higher temperature than ordinary glass

will withstand, and at the same time the light will become almost white in color. Now, if this tube be made of quartz, melted and blown at very high temperatures and then very slowly annealed, the arc can be maintained indefinitely, giving, with 3 amp and 110 volts, 1000 cp, or, with 3 amp and 220 volts, 2000 cp. At the same time the lamp proper is of very small size, capable of being mounted with all the mechanism inside the globe of an ordinary arc lamp. Given, then, a glower of from 1000 cp to 2000 cp, having no consumption of active material and yet of such compact and convenient size the possibility of assembling a unit of high lighting value having all the advantages of the arc and none of its disadvantages, becomes apparent. It is along these lines that Mr. Von Keller, working in the shops and laboratories at Bas Meudon, near Paris, has developed the above-mentioned form of the lamp, the first to be put in successful commercial service.

The photographs reproduced herewith show the outside appearance and interior construction pretty clearly. It will be noted that the mechanical construction is identical with the familiar Cooper Hewitt lamp. There is the usual tipping mechanism—a solenoid with cut-out magnet and resistor to adjust the latter to cut out the solenoid when the resistance of the arc reaches a certain point. Mounted above this mechanism are three horizontal iron coils on porcelain bobbins, which serve to adjust the voltage delivered to the arc from the particular line voltage at which the lamp may be operated. Into the quartz tube glass trunnions have been blown at one end, and a glass condenser bulb at the other, as only the tube itself is subject to the intense heat of the short mercury-vapor arc.

When the circuit is closed the solenoid acts to tip the condenser bulb and strike the arc. As soon as this latter grows to a certain point (which requires about three seconds) the magnet on the trip-switch opens and cuts out the solenoid, which instantly lets the tube fall back to its normal position of running. The above is the whole mechanism of the lamp, simple and not at all delicate or liable to get out of order. It resembles a miniature standard mercury-vapor lamp.

The sole point of danger lies in the ultra-violet rays, which are present in this lamp as in the large mercury-vapor arc. Ordinary lead glass intercepts these rays so as to remove all danger to eyesight, but they readily pass through quartz. Beyond a distance of 9 ft. from the lamps they are not at all harmful, but when one is closer it is advisable to wear goggles when viewing the naked glower unprotected by the lead-glass outer globe. Of course, in practical service, the outer globe protects the eyes from these rays always, and, as the lamp is hung from 20 ft. to 30 ft. above the ground, even a breakage of the outer globe would not result in harm to the eyes.

The specimens of the quartz used in the manufacture were ordinary large quartz crystals, both transparent and opaque, the only requirement seeming to be that they must be absolutely free from iron, manganese or such impurities. At present writing, no curves of luminous intensity have been plotted, the work in that line having been principally to get a standard to measure the candle-power of the lamp by, ordinary photometers not being of much use for comparisons. The writer has had considerable occasion to judge light distributions of various lamps offered for test, and ventures to state that the distributions of this lamp will be found to be nearly uniform, completely around the glower. There was no change in light values nor any shadows noticeable, in walking under and around the lamp observed, and, the source being a luminous cylinder of quartz, 0.75 in. in diameter by 5 in. long, set horizontally, there should be virtually uniform distribution of light.

The lamps operate in multiple, like ordinary incandescent lamps, fed either through an independent switch or out of any socket that will carry 3 amp. It, therefore, has great freedom and flexibility of installation, as no series or series-multiple scheme has to be worked out in installing it. Compared with arc lamps it has more brilliance than the ordinary blue-flame arc, and about the same as the flaming arc. The light, however, is more agreeable than that of either of the other two, having a great deal of yellow in it, and being very diffused, so that the thinness and sharp shadowing of the blue arc is displaced by a flood of near-daylight and the glare and red color of the flaming arcs are avoided in this lamp. Moreover, there are no high-priced electrodes to replace every 17 hours and no electrician's time to charge against renewing electrodes and cleaning globes. Working about an industrial plant one electrician could take care of about 40 lamps in a day's work, making the charge for this 7.5 cents per day per lamp for the blue-arc, saying nothing of the electrodes nor of the 7 amp current against 3 amp for the quartz-tube mercury-vapor lamp.

The quartz-tube, mercury-vapor lamps are sold in Paris for $41 for the 110-volt, 1000-cp size, and $47 for the 220-volt, 2000-cp, with a charge of $6 for renewal of the quartz tube in either size. The life of the burner is put at 2000 hours, though theoretically it is indefinite, and the company guarantees to replace any burned out tube, free of charge, inside of 1000 hours' service. The tube is easier to replace and requires less care and judgment than do arc-lamp electrodes. Even at 1000 hours the cost for tubes would be 0.6 cent a lamp-hour, considerably below that of electrodes, and in actual practice it will probably prove that the average life of the tubes will far exceed 1000 hours.

The height of suspension for best results is given as 20 ft. for the 1000-cp size and 30 ft. for the 2000, but these lamps will probably be lowered to about 15 ft., just as has been done with the flaming-arc lamps under the desire of humanity for the cheerful effects of a flood of electric light at night. For operation in places where there are dangerous and inflammable gases, the quartz-tube mercury-vapor lamp is open to the same objections as the green mercury-vapor lamp—the spark given out by the automatic cut-out hammer, which releases the solenoid, is absolutely fatal to its use in oil yards, chemical works, mines and other places where explosive gases exist. Although conclusive experiments have probably never been made along the lines of Sir Humphry Davy's law that a spark cannot ignite through gauze, yet it seems that there are two ways of overcoming the spark danger now that the green-light nuisance is obliterated; the first is by enclosing the hammer mechanism in wire gauze, and the second by eliminating the automatic cut-out entirely, the solenoid being released by a snap switch placed in the same box as the main switch at a safe distance from dangerous gases.

While the quartz-tube mercury-vapor lamp is at present arranged for direct current only, there is no reason why it cannot be used with a small mercury converter and thereby rendered available for alternating-current plants. This arrangement would very greatly extend its sphere of usefulness, because most large industrial plants necessarily and preferably use alternating current and it is not desirable to complicate the installation by the introduction of special direct-current equipment for the sake of the arc lamps.

VOLTAGE REGULATION OF STATIONARY TRANSFORMERS.

By E. H. Acton.

DURING the past 10 years several formulas have appeared for calculating the regulation of a transformer. These formulas differ from one another, giving results which may vary several per cent. Some of the formulas have corrections for exciting current and some have none. It is the purpose of the present article to derive formulas for calculating regulation and to show that in good commercial designs the regulation is practically independent of the exciting current. The subject will be considered in three divisions, namely, with no exciting current, the effects of the exciting current when the transformer is loaded, and the effects of the exciting current when the load is thrown off.

The Standardization Committee of the American Institute of Electrical Engineers defines regulation as: "The ratio of the rise of secondary terminal voltage from rated non-inductive

load to no load (at constant-primary impressed terminal voltage) to the secondary terminal voltage at rated load."

In the following figures and discussion, let

$\overline{OH}$ = the primary impressed terminal voltage.

$\overline{HG}$ = e.m.f. absorbed by the reactance of the primary winding to the load component of the primary current.

$\overline{GC}$ = e.m.f. absorbed by the resistance of the primary winding to the load current.

$\overline{CO}$ = e.m.f. set up in the magnetic circuit.

$\overline{CB}$ = e.m.f. absorbed by the reactance of the secondary winding to the secondary current.

$\overline{BA}$ = e.m.f. absorbed by the resistance of the secondary winding to the secondary current.

$\overline{AO}$ = secondary terminal voltage (rated secondary voltage of the transformer).

$\overline{DO}$ = current in the secondary winding (rated secondary current of the transformer).

$\overline{OF}$ = current in the primary winding.

$\overline{OE}$ = exciting component of the primary current.

WITH NO EXCIT NG CURRENT.

Fig. 1 is a vector diagram of a "one-to-one" transformer having no exciting current and supplying energy to a non-

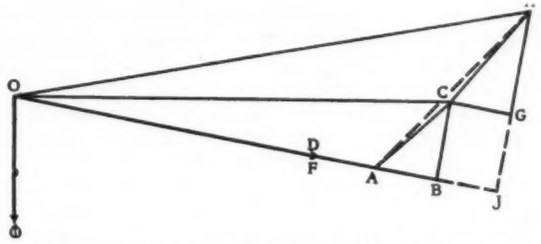


Fig. 1—Vector Diagram of Transformer Without Exciting Current.

inductive circuit. The triangle $\overline{AJH}$ represents the e.m.f. consumed by the impedance of the transformer to the load current in the secondary and primary windings, hence when the load is thrown off these vectors disappear and the e.m.f. at the secondary terminals becomes $\overline{HO}$. The regulation of such a transformer is expressed as $(\overline{HO} - \overline{AO}) \div \overline{AO}$.

WITH EXCITING CURRENT; TRANSFORMER LOADED.

The condition discussed above is purely theoretical and does not occur in practice, since all commercial transformers have an exciting current. This current should not be neglected when calculating performances, as it will usually have an appreciable effect on the efficiency and power-factor of the circuit.

If the above transformer be assumed to have an exciting current, then the primary current will be increased and its phase changed; there will be an increase in the copper loss, and

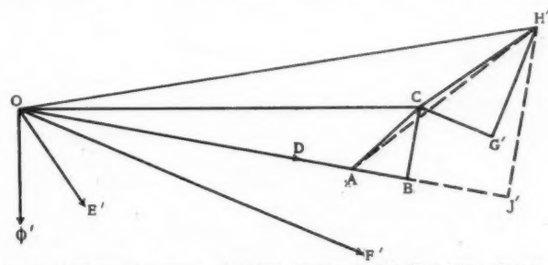


Fig. 2—Vector Diagram of Transformer With Exciting Current.

an increase in the primary impressed voltage will be required for the same secondary terminal voltage.

Fig. 2 is a vector diagram for the above condition. It will be noticed that the triangle $\overline{H'G'C}$ is larger than $\overline{HGC}$, also $\overline{G'C}$ is not parallel to $\overline{BA}$. These effects of the exciting current can best be shown by separating the e.m.f. which it sets up from those of the load component of the primary current.

Fig. 3 represents the same condition as Fig. 2, but with the e.m.fs. of the load and exciting components of the primary current separated. It will be noticed that the impedance triangle $\overline{AJH}$ is the same as in Fig. 1, since it involves only the load current in the secondary winding, and its component of the

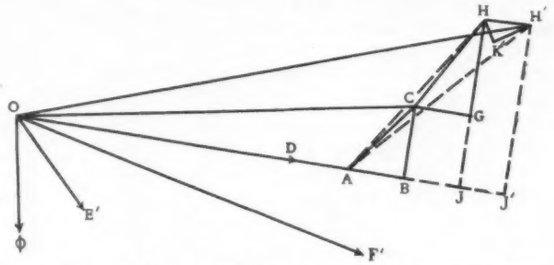


Fig. 3—Vector Diagram of Transformer With Exciting Current.

primary current. Also triangles $\overline{AJ'H'}$ of Figs. 2 and 3 are the same, since they represent the aggregate effect of the secondary current and the load and exciting components of the primary current.

The effect of the exciting current in increasing the required primary impressed voltage is very apparent, as its impedance drop $\overline{H'H}$ is almost directly opposed to $\overline{OH}$. In this figure $\overline{H'K'}$ is the e.m.f. absorbed by the reactance of the primary winding to the exciting current and $\overline{K'H}$ is the e.m.f. absorbed by the resistance of the primary winding to the exciting current.

WITH EXCITING CURRENT; TRANSFORMER WITHOUT LOAD.

Fig. 4 is a vector diagram for the same transformer when the load is thrown off, the primary impressed terminal voltage being kept constant. $\overline{C''O}$, the e.m.f. of the magnetic circuit, is the same as $\overline{A''O}$, the e.m.f. at the secondary terminals, also in this diagram $\overline{OH'}$ has the same value as in Fig. 3. However, $\overline{A''O}$ is not the same as $\overline{HO}$, the reason being as follows:

In Fig. 3 the exciting current $\overline{OE'}$ is a function of the e.m.f. $\overline{CO}$. In Fig. 4 the exciting current $\overline{OE''}$ is a function of the e.m.f. $\overline{C''O}$. Since $\overline{C''O}$ must have a value somewhere between $\overline{CO}$ and $\overline{HO}$ (the drop $\overline{HC}$ disappears when the load is thrown

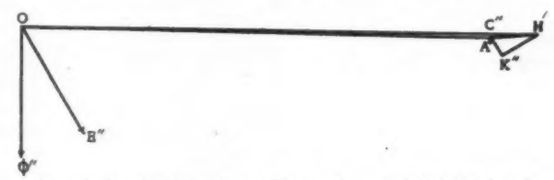


Fig. 4—Vector Diagram of Transformer Without Load.

off) it follows that $\overline{OE''}$ will be larger than $\overline{OE'}$ and hence its impedance drop $\overline{H'C''}$ will be larger than $\overline{H'H}$.

If $\overline{H'C''}$ is greater than $\overline{H'H}$, then $\overline{A''O}$ must be less than $\overline{HO}$, since all four e.m.fs. are practically in phase with each other. As $\overline{A''O}$ and $\overline{HO}$ are the voltages at the secondary terminals it follows that the regulation of a transformer with an exciting current is better than one assumed to be without.

In well-designed transformers this increased drop due to the exciting current will not usually be appreciable, since the rise in the e.m.f. of the iron circuit when the load is thrown off will not cause the magnetic flux to pass the knee of the saturation curve.

The "improved" regulation caused by the increased exciting current is only an apparent improvement and not real, since the improvement is merely one of definition. It is easily seen that any increase in the e.m.f. of the iron circuit means increased losses in the transformer, line and generator and is not to be desired. While this increase in losses may reach an appreciable value, still in the case of most commercial designs it may be neglected.

The data for calculating the regulation of a transformer may best be obtained from impedance measurements taken when one winding is short-circuited and sufficient voltage impressed on the other winding to circulate full-load current. Fig. 5 shows the connections to be made when measuring the impedance voltage and copper loss by this method. The ammeter should not be put in the secondary circuit, as its impedance will frequently vitiate the results, particularly when a series transformer is used. With the connections as shown, the exciting and instrument currents will be included with the transformer current; however, the error introduced will usually be much less than when the ammeter is in the other circuit. Readings should be taken for several values of current, the proper corrections should be made and the average impedance calculated. The copper loss should be *measured* when full-load current is circulating in the windings and not calculated from the resistances measured with direct-current, as these do not include the *"load losses."*

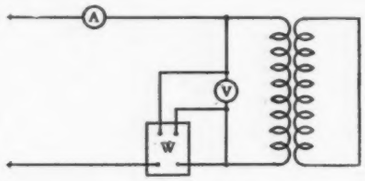


Fig. 5—Arrangement of Instruments for Impedance Tests.

Let R = per cent copper loss.
X = per cent reactance e.m.f.
Z = per cent impedance e.m.f.
V_1 = primary impressed terminal voltage.
V_2^1 = secondary terminal voltage divided by the ratio of transformation.
E = per cent exciting current.

By definition, regulation $= \dfrac{\overline{A''O} - \overline{AO}}{\overline{AO}}$

assuming $\overline{H'C''} = \overline{H'H}$, then $\overline{A''O} = \overline{HO}$

and regulation $= \dfrac{\overline{HO} - \overline{AO}}{\overline{AO}}$

from Fig. 3 $\overline{HO} = \sqrt{(\overline{AO} + \overline{JA})^2 + \overline{HJ}^2}$

expanding, etc., the percentage regulation $= R + \dfrac{X^2}{200}$

The effect of the exciting current in increasing the primary impressed terminal voltage may be calculated from the following formula based on Fig. 3:

$$V_1 = V_2^1\left[1 + \frac{R}{100} + \frac{X^2 + EZ}{20{,}000}\right]$$

Example:

Rating of transformer	= 100 kw
Frequency	= 25 cycles.
Primary e.m.f.	= 2200 volts.
Primary current	= 45.5 amp
Secondary e.m.f.	= 220 volts.
Secondary current	= 455 amp

The following measurements were taken:

Frequency.	Amperes.	Volts.	Copper loss.	Temperature.	Impedance.
25	47.0	71.0	...	25°C.	1.511
25	45.5	69.0	1950	25°C.	1.516
25	42.5	64.5	...	25°C.	1.518
25	40.6	62.0	...	25°C.	1.527
Average					1.518

The average impedance voltage for full load is 69.1
The per cent impedance voltage for full load is $3.14 = Z$
The per cent copper loss for full load is $1.95 = R$
The per cent reactance e.m.f. for full load is $\sqrt{Z^2 - R^2} = 2.46 = X$
The per cent regulation is

$$1.95 + \frac{(2.46)^2}{200} = 1.95 + 0.03 = 1.98$$

If it be assumed that E is 1.1 per cent, then

$$V_1 = 2200\left[1 + \frac{1.95}{100} + \frac{(2.46)^2 + (1.1)\ (3.14)}{20{,}000}\right] \text{volts}$$

$$= 2200\ [1 + 0.0195 + 0.00048] \text{ volts}$$

$$= 2200\ [1.02 \text{ volts}]$$

$$= 2244 \text{ volts.}$$

In the case of a transformer supplying energy to an inductive load whose power-factor is cosine θ, the formulas are:

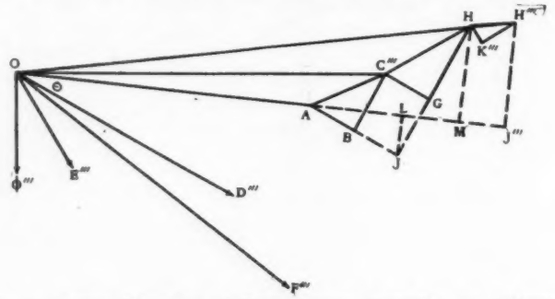


Fig. 6—Vector Diagram of Transformer Carrying an Inductive Load.

per cent regulation $= R \cos \theta + X \sin \theta + \dfrac{(X \cos \theta - R \sin \theta)^2}{200}$

$$V_1 = V_2^1\left[1 + \frac{R}{100}\cos\theta + \frac{X}{100}\sin\theta + \frac{(X\cos\theta - R\sin\theta)^2 + EZ}{20{,}000}\right]$$

The vector diagram for this case is shown in Fig. 6.

Central Station

Management, Policies and Commercial Methods

EXTENSION OF STANLEY HOTEL ELECTRIC HEATING AND COOKING EQUIPMENT.

The electrical heating and cooking equipment of the Stanley Hotel, at Estes Park, Col., which was described in the issue of Sept. 2, 1909, has proved so satisfactory that additional equipment is being installed. In this hotel no coal whatever is employed. All room heating, baking and water heating for all purposes and all cooking are done by alternating current at 110 volts and 220 volts, supplied by a special transformer station from a small water-power development, also owned by Mr. F. O. Stanley. A new winter hotel is being constructed and except for the heating in severe weather, electricity will be used for all purposes in this building also. About 100 kw capacity is ordinarily used in the kitchen. Coal costs about $10 or $11, and electrical energy about 2 cents per kw-hour, including interest and depreciation.

FOLLOW-UP ELECTRICAL ADVERTISING.

A housefurnishing company in a large Western city makes a practice of sending to young couples whose names appear among the marriage-license returns, a booklet of practical suggestions and advice on how to begin housekeeping, etc. The enterprising central-station company of the same city purchases advertising space in this booklet, setting forth its electric milk warmers and other heating conveniences, and reports profitable returns from this specialized form of advertising.

SALES HINTS.

The organ of the Boston Edison Employees' Club, *Edison Life*, suggests that employees of the company can assist in selling the little things—the conveniences that make electricity popular and brings the company money, and offers hints, as below, how this may be accomplished:

"When you hear that a friend is sick, tell him about the electric heating pad. It don't leak, stays hot, costs half-a-cent an hour to use.

"Ask your friends how they make toast. An electric toaster is the best, on the table, hot on the spot, quick, cheap. Four pieces for less than a cent.

"When you see frost or steam on the windows of the store you trade in, tell 'the boss' an electric fan will drive it away for a cent and keep it away for a few more.

"Tell your tired housekeeping friend about the electric flat-iron. Hot when you want it, where you want it, and does a week's ironing for a few pennies."

HOW TO MEET GASOLINE LIGHTING COMPETITION.

BY JUDSON H. BOUGHTON.

With gasoline lighting competition, as with most other evils, the prevention is much simpler than the cure. This subterfuge, for such it is, is the direct outgrowth of unsatisfactory service or unreasonable charges or both for electricity, which is admittedly the best medium known for furnishing artificial light. Satisfactory service, it must be remembered, embraces not only modern generating and distributing practice, close regulation of voltage, and freedom from interruptions, but also courteous treatment of patrons by representatives of the electric company. Reasonable charges are those which recognize different classes of consumers, according to the cost of serving each class, and which share with the long-hour user a reasonable part of the saving in furnishing service as the period of daily use increases.

The introduction by the several electric properties (National Light and Improvement Company), in which the writer is interested, of a sliding scale of rates based upon the period of use has done much in each case to eliminate agitation as to excessive charges and to check the invasion of gasoline. These particular rates in which the cost of fuel is a factor are 12½ cents for the first 3 kw-hours used in the given month per lamp installed, 10 cents for the second 3 kw-hours, 7½ cents for the third 3 kw-hours, and 5 cents for all current used in excess of 9 kw-hours per lamp. These increments are based upon an average use of two hours per day for each lamp installed, for 25 days of each month. This requires the short hour or peak patron to pay the maximum rate, which it is proper that he should; and the consumption being small, complaints are seldom made by this class of users. The long hour user also receives the reduction to which he is justly entitled, enabling him to secure long-hour service at a cost which compares favorably with the real cost of the much less satisfactory gasoline lighting.

Incidentally, this system of rates, which may, of course, be modified even to the "readiness-to-serve" charge plus a low rate for current actually consumed, though the latter is less readily understood and accepted, permits fans to be carried on the lighting system at a fair rate without the necessity of opening accounts for a few months, or of setting and removing special meters at the beginning and end of each fan season.

In the absence of some such equitable rate for long-hour usage, the long-hour user who has any consideration for economy—and there are few patrons who ignore the size of their electric bills—is practically forced to use the gasoline system, which, even with equitable rates, is sometimes adopted because of lack of good service or proper attention on the part of the electric company.

Gasoline lighting plants provide an outlet for a large amount of the product of interests which are both powerful and well organized. They furnish a very satisfactory light, and the cost of the fuel—gasoline—which is usually the only item considered, is very low. When once well established, gasoline lighting plants are very difficult to dislodge, even with good service, attractive rates, and the most careful attention.

The tungsten lamp is the strongest weapon of the central station in the fight against gasoline lighting. With the first sign of dissatisfaction on account of excessive bills for electric light, it is good policy to introduce the tungsten lamp. Even where free renewals of the carbon lamps are furnished by the electric company, it is not usually desirable to furnish free the more expensive and more fragile tungstens even to hold a dissatisfied consumer. Usually, however, if the company supplies the tungsten lamps for trial purposes, the resulting reduction in the bill for current will convince the consumer of the wisdom of purchasing the tungsten lamp and its introduction will serve to stop any agitation for gasoline lights. Cases where consumers have adopted gasoline after first giving tungsten lights a fair trial are very rare.

Once the gasoline light is installed, however, the problem becomes much more complex unless the company is willing to reimburse the consumer for the cost of the gasoline outfit, which would create an undesirable and expensive precedent and place the company in an unfortunate light before its patrons generally.

The best plan is to furnish tungsten lamps together with whatever fixtures may be required to make them effective upon trial for 30 or 60 days, making no charge during this period except for the current used and with the understanding that if they prove satisfactory the consumer may either purchase the tungsten equipment outright for a certain agreed cash price, or purchase on installments, or simply rent it. When permission to make this trial is secured, special care must be taken to select and locate the lamps and fixtures so as to secure the very best results possible. Then during the trial period the persons in charge should be watched and coached to see that the lamps are not burned unnecessarily so as to run up an unduly large bill; and finally the consumer must be educated as to the real cost of gasoline lighting in order that a fair comparison of the two systems may be made before final conclusions are reached. It may safely be assumed that the cost of lighting is the chief consideration, for gasoline is never given the preference over electricity on any other basis, unless, of course, some special grievance exists or other abnormal factor is present.

There are two general systems of gasoline lighting. The so-called "hollow wire" apparatus embraces a tank containing gasoline under pressure obtained by an ordinary hand air-pump, and lamps with attached vaporizers or generators fed with gasoline from the tank through very small flexible copper pipe or hollow wire. This outfit, which seldom includes more than two to four lights, ordinarily costs from $15 to $30 and is cheap in every sense. Its operation requires that gasoline be carried through the building at high pressure in an easily damaged pipe; it is necessary to heat each burner with a torch before the lamp will operate; the lamps are of small candle power, it being impracticable to group burners into clusters; and the lamp is noisy and frequently emits fumes. Although exceedingly inexpensive, both to install and to operate, there are so many objectionable features to this class of gasoline apparatus that it is seldom met in competition except among the very poorest class of small stores and similar establishments whose patronage is, in any event, the least desirable of any lighting business. Although cost almost always rules absolutely with these people, their business can frequently be secured with tungsten lamps on drop cords operated with a wall switch; and it is, of course, worth while to keep out all gasoline competition, even in this form.

The first and operating costs of the more substantial independent generator or so-called "fool proof" outfits give the electric man more to work upon. This apparatus, which includes a separate generator supplying all lamps through about ½-inch ordinary gas pipe, costs from $125 to $200 installed for a four-light outfit, the cost varying with the length of pipe required. The average life of this apparatus may be taken as

five years, so that assuming the cost to be $150, the annual depreciation is $30, or $2.50 per month. Adding 6 per cent for interest, 5 per cent for repairs and 2 per cent for taxes and insurance the total fixed charges become 33 per cent, or $49.50 per year, or $4.12 per month. Mantle renewals are not included in the repair allowance, but they are just about offset by the cost of tungsten renewals. For electric fixtures and lamps of corresponding attractiveness and candle-power, the first cost would be considerably less, and no such charges could be made with fairness against the electric equipment. In ordinary cases, fixed charges of $1 per month are adequate for the corresponding electric equipment, leaving the fixed charges on the gasoline outfit at least $3 more per month. This excess cost should be added to the cost of the gasoline and labor required in the operation of the lights, but when the gasoline apparatus is already installed it is frequently necessary for the central station man to make at least some allowance for the outfit when electric lights take its place, in order to make the argument as to fixed charges effective.

The monthly cost of gasoline, which seems to vary considerably, can usually be obtained from the consumer himself, for ordinarily this is the only cost he recognizes at the outset and he is frequently quite proud of the low figure. The cost of labor in maintaining and operating the gasoline apparatus is difficult to establish, and many consumers will contend that no extra help is required and that there is no extra expense. All these points, however, are well worth emphasizing, and with the advantages, which will become manifest during the trial, of convenience, cleanliness, reliability, safety and absence of special insurance restrictions, the electric man should be able to make a strong case when the time comes for summing up the costs and advantages, and for deciding between gasoline and electricity.

HIGH LOAD FACTORS AT DAYTON, OHIO.

The possibilities of increasing the output of central stations by selling energy at non-peak periods and thereby increasing the load-factor and the earnings per kilowatt of station equipment have been frequently discussed, pro and con, among central-station men. Years ago it was common, and in some quarters it is still common, to hear central-station men say that the sale of energy under contracts which provide for the discontinuance of its use during the peak lighting load of the plant

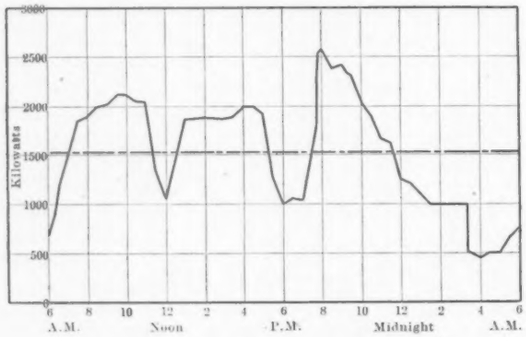


Fig. 1—Total Load Curve June 29-30, 1909.

is impracticable. However, it has been demonstrated by a number of companies that such non-peak contracts can be secured and enforced, much to the improvement of the company's load factor and earnings per dollar invested. In this connection the accompanying curves from Dayton, Ohio, showing the load of the Dayton Lighting Company for various typical days of the year are of much interest.

Fig. 1 shows the total-load curve for 24 hours, from 6 a. m., June 29, to 6 a. m., June 30, 1909. This is a typical June day selected as being as near an average day as possible. The total kw-hours generated numbered 36,700; the average load was 1530 kw, and the maximum load 2535 kw. The load factor calculated according to the A. I. E. E. definition (that is, the percentage which the average load is of the maximum) is 60.3 per cent for this curve. The load factor based on the total

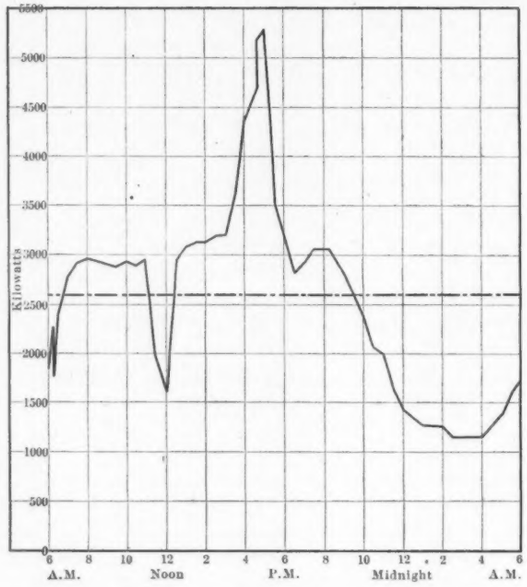


Fig. 2—Total Load Curve December 10-11, 1909.

generator rating of the station (4700 kw), and ordinarily called the "station factor," is 32.6 per cent.

Fig. 2 shows the total-load curve for a typical December day, for the 24 hours from 6 a. m., Dec. 10, to 6 a. m., Dec. 11, 1909, aggregating 62,660 kw-hours. The average load was 2607 kw; the maximum load 5295 kw. Correspondingly, on account of the high peak load which always comes in December, the load factor for this day is not as high as in June, being 49.3 per cent. The station factor, however, is much higher because the plant is being run nearer to its generator rating of 4700 kw.

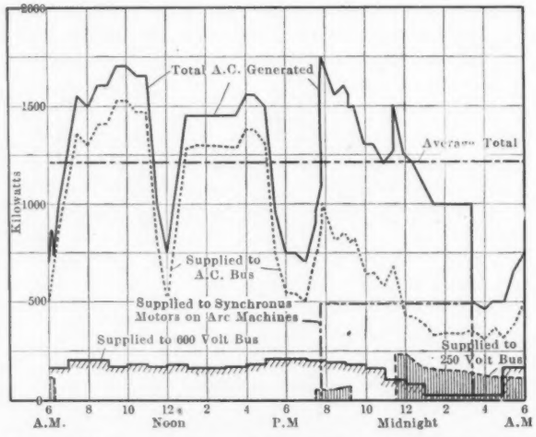


Fig. 3—Alternating-Current Load Curve June 29-30, 1909.

In fact, the peak load exceeded the rating of the generators. This station factor was 55.5 per cent.

Fig. 3 shows the alternating-current load curve for 24 hours from 6 a. m., June 29, to 6 a. m., June 30, 1909, aggregating 29,000 kw-hours. This is for the same period as the total-load curve, Fig. 1. It shows the amount of the company's output which is carried on the alternating-current lines as compared to the direct-current lines. The local alternating-current distribution is comparatively new, the service outside of the downtown district having been given for only a few years. From the curve it will be seen that a certain number of motor-driven arc

machines are used for street lighting, these motors taking 500 kw continuously during the street-lighting hours. The average alternating-current load was 1208 kw; the maximum 1750 kw, so that the alternating-current load factor in Fig. 3 is 69 per cent. As the alternating-current generating rating is 3500 kw, the alternating-current station factor is 34 per cent. Of the total 29,000 alternating-current kw-hours generated 20,400 kw-hours was supplied to the alternating-current buses, 3460 kw-hours to the 600-volt bus, 1340 kw-hours to the 250-volt bus, and 3800 kw-hours to the synchronous motors driving the arc machines.

Fig. 4 shows the alternating-current load curve for the same day as the total-load curve in Fig. 2, Dec. 10 to 11. This curve also indicates the distribution of the alternating-current output

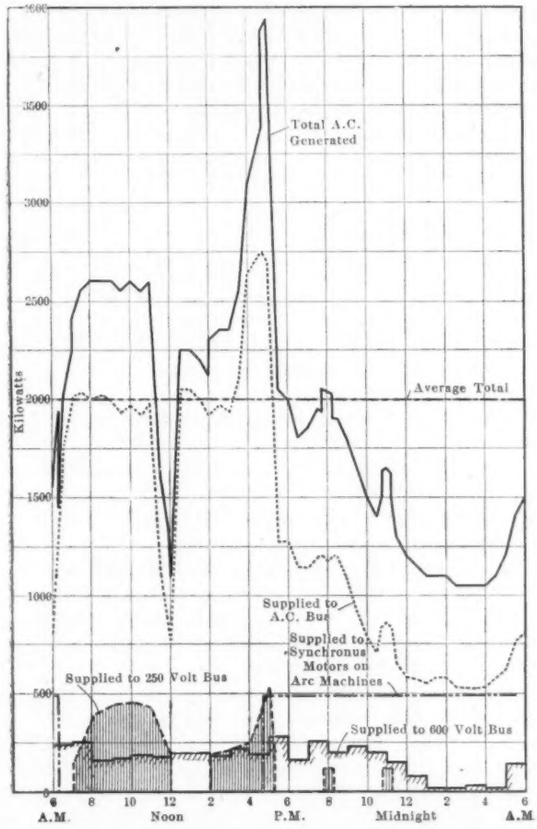


Fig. 4—Alternating-Current Load Curve December 10-11, 1909.

for different purposes in the station. Thus, of the total 48,000 alternating-current kw-hours generated, 34,310 was supplied to the alternating-current busbars, 3970 kw-hours to the 600-volt bus, 3020 kw-hours to the 250-volt bus, and 6700 kw-hours to the synchronous motors driving the arc machines. The average total load was 2000 kw. and the maximum reached 3950 kw. As the total generating rating was 3500 kw the load factor was 50.7 per cent, and the station factor 57.2 per cent.

Fig. 5 is the direct-current load curve for the same day in June as the total-load curve in Fig. 1, and showing a total direct-current output of 9040 kw-hours, of which 7700 kw-hours was generated directly and 1340 kw-hours supplied by a rotary converter. The average direct-current load represented was 377 kw, the maximum having reached 913 kw; thus a load factor of 41.2 per cent is indicated. As the total rating of both generator and rotary converter was 1700 kw, the station factor for Fig. 5 is 22.2 per cent.

Fig. 6 shows the direct-current load curve for the same day in December as the total-load curve shown in Fig. 2. Of the total direct-current output of 17,680 kw-hours on this day 14,660 kw-hours was supplied from the generators and 3020 kw-hours from the rotary converter. Although the direct-current load reached a peak of 1865 kw, its average value was 736 kw, representing a load factor of 39.5 per cent. The aggregate rating of both generators and rotary was 1700 kw, so that the station factor was 43.3 per cent.

The lesson to be drawn from these curves and figures is in the remarkably high load factor which this company has been

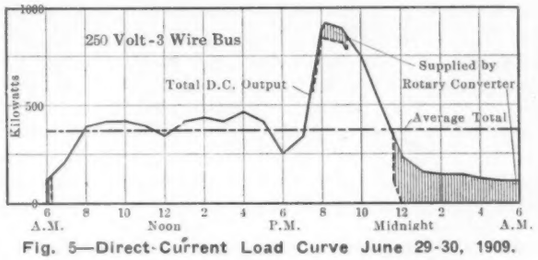


Fig. 5—Direct-Current Load Curve June 29-30, 1909.

able to attain. This high load factor is especially noticeable on the alternating current part of the plant, which is due to the fact that non-peak contracts calling for energy which is not used during the company's peak, have been made in the alternating-current territory outside of the downtown district, with the numerous factories. An inspection of the curves shows the existence of a motor load during the day of no mean

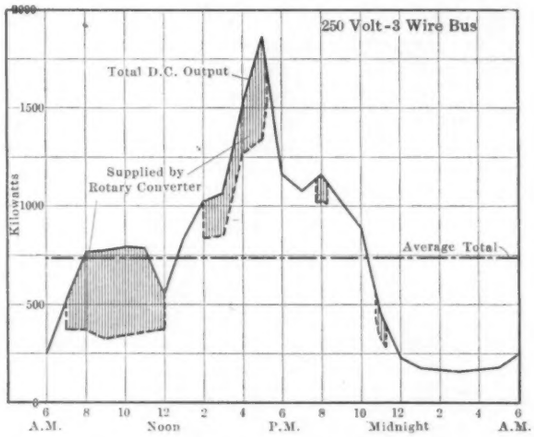


Fig. 6—Direct-Current Load Curve December 10-11, 1909.

proportions. Some of this load is, of course, on during the peak, but the load factor and output per dollar invested in stations and lines would not be nearly so high were it not for these non-peak contracts.

Wiring and Illumination

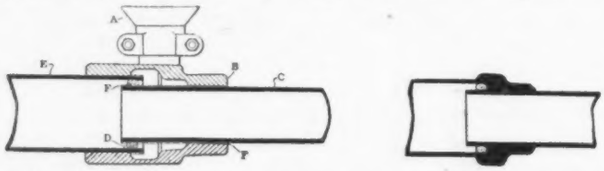
JOINTING OF LEAD COVERINGS FOR CABLES.

A method of jointing the lead covering of cables involving the use of a special welding compound is being generally introduced in England after having been in successful use by the Fulham Borough Electricity Works for the past two years. The welding compound consists of a ribbon of pure tin 0.05 mm in thickness treated to prevent the formation of oxides during heating with "Amalgaline" composition, for which a patent is held by Mr. T. Harden. The lead surfaces to be joined are cleaned in the usual way, and a sheet of the specially prepared tin is inserted between them. The joint is then heated with a blow-torch, and the melting of the tin causes the lead surfaces on either side of it to melt at a lower temperature than the normal melting point of lead; an actual weld is thus formed between the two surfaces.

In the case of a joint in the ordinary lead-covered cable, after the conductors have been jointed and insulated, the lead sleeve is drawn over the joint, a strip of "Amalgaline" is wrapped

round the lead covering of the cable at each end and the sleeve is properly "dressed down." Sufficient heat is then applied to the sleeve and the joint is complete.

With telephone, telegraph and other large dry-core cables it is not always desirable to dress down the heavy lead used for sleeves, and hence for such work a mold is used, as illustrated in the accompanying illustration. The sleeve is passed along the cable in the usual way before the conductors are jointed and the jointing is proceeded with; when completed, the sleeve is scraped clean inside for a short distance, the outer surface of the lead of the cable being similarly treated. A piece of "Amalgaline" is placed on the cleaned part in the interior of the sleeve, and another piece *F* is wrapped round the lead sheathing of the cable. The sleeve *E* is then drawn into position, and a piece of ordinary engine packing *D* is driven between the



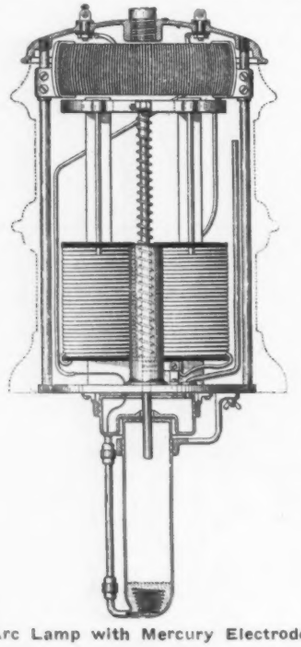
Figs. 1 and 2—Method of Casting End, and Finished End of Sleeve.

cable and the sleeve. The mold *B* is then placed in position and molten lead poured in. An important feature is that the mold is so constructed that the hot metal runs directly from the pouring gate to the space beneath the cable, and then wells up round the cable, so that there is no risk of the lead being burned through by the metal being poured directly on to it. The time for plumbing a large telephone cable is said to be reduced by about 30 minutes.

The system is also advocated for making tee joints in lead-covered cables and small house-service boxes made entirely of lead are now being used. These are divided in the usual way, but require no packing. When the joint is complete, "Amalgaline" is placed between the flanges and round the cables where they enter the box, and the whole is heated up and welded water-tight. Of course, no supplementary bonding is required.

ARC LAMP WITH MERCURY ELECTRODE.

In the accompanying illustration is shown an arc lamp using mercury as one electrode and either iron or aluminum as the



Arc Lamp with Mercury Electrode.

other, for which a patent was issued to Dr. C. P. Steinmetz Dec. 7, 1909. Use is made of mercury because it volatilizes at a low temperature and furnishes a light of considerable intensity. However, the light from mercury used alone would not be suitable for general application by reason of the marked absence of the longer light waves corresponding to the yellow, orange, and red. The color can be modified to a satisfactory extent by introducing salts of one of the halogen group, preferably iodin. The use of the halogens is of special value when the arc exists in a completely closed vessel capable of excluding moisture. In the present patent the inventor proposes the use of meta-silica of lithium, which dissociates in the temperature of the arc whereupon the lithium is free to produce the desired color, while the chemical activity of the radicals is more or less neutralized, each by the other, owing to the fact that they exist in the ionized state. Nevertheless, an exchange of bases takes place between the silicates and the hard glass used as an envelope, and there is continual chemical action on the inner surface of the envelope, a composition and decomposition of the glass, a tearing down at one place and a building up at another. However, the various silica salts thus formed on the inner surface of the tube are transparent, or at least translucent, and the only effect is to give to the inside of the tube a frosted appearance, similar to that of the well-known frosted incandescent lamps. This action does not cut down the light to any serious extent, particularly in view of the very high efficiency of the lamp, and only serves to cause the tube to present the appearance of a solid source of uniform and agreeably diffused light.

OPERATING CHARACTERISTICS OF TUNGSTEN LAMPS.

Bulletin No. 33, issued by the Engineering Experiment Station of the University of Illinois, contains a detailed report of tests of tungsten lamps made by Messrs. T. H. Amrine and A. Guell. The tests were made upon lamps designed for 25 watts, 110 volts, and rated to consume 1.25 watts per candle. There were three types of lamps designated respectively as *C*, *D* and *P*. The *P* lamps were of American manufacture, and the others of German make. The lamps are shown in Fig. 1.

The German lamp *C* was made by the colloid process. In this method colloidal tungsten is formed either by maintaining an arc between tungsten electrodes under some liquid, it may be water, or by reducing tungstic trioxide with potassium cyanide. This plastic colloidal mass is brought to the proper consistency, and is then squirted through a die to form a filament, as in the paste process. The filament so obtained is dried and is gradually brought to a white heat in a non-oxidizing atmosphere, and is thereby converted into the crystal-

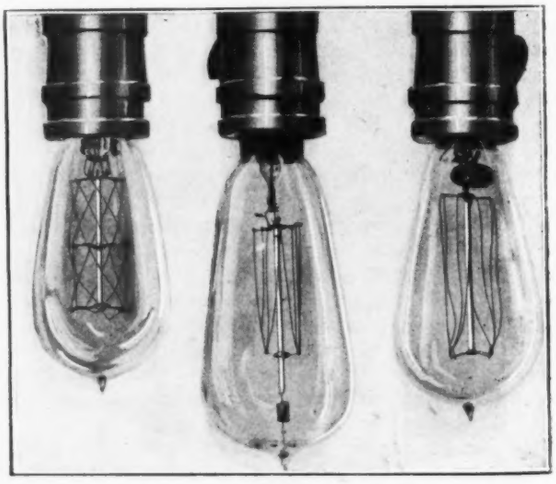


Fig. 1—Filaments of Lamps C, D and P.

line state. The filament in this lamp, too, consists of four loops, each of which is mounted in a peculiar spiral shape and

hung loosely enough to permit of contraction. The joints between the filaments and the base spires are fused as in the *P* lamp.

The filaments of the German lamp *D* were made by the deposition process. In this method a fine filament of carbon is heated in an atmosphere of some compound of tungsten, for instance, oxychloride of tungsten. This treatment causes the metal to be deposited in a shell upon the carbon core. By the

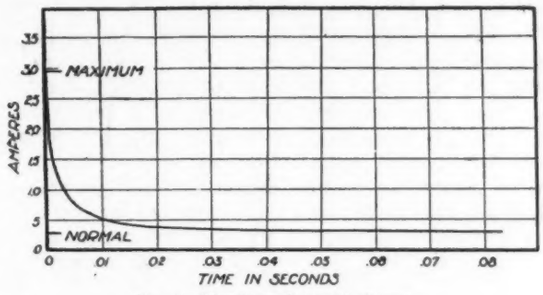


Fig. 2—Starting Current Curve.

application of heat the tungsten and carbon are made to unite chemically to form tungsten carbide, which is then reduced and the carbon removed by a method similar to that employed in the paste process. The filament in this lamp consists of four loops; the supporting spires at the tip end of the stem are very thin and flexible springs, and the filament is kept under a slight tension by their action. The flexibility of these spires also permits contraction of the filaments to take place. The entire glass stem which carries the filaments is mounted between two coil springs, as shown in Fig. 1. The object of these springs is to absorb the jar and vibration to which the lamp may be subjected and so prevent breaking the filament. Connections between the filament and spires at the base end of the stem are made by means of pasted joints.

The filaments of the American lamp *P* were manufactured by the paste, or Auer, process. In this method, which is similar to the one used in making ordinary carbon filaments, finely powdered tungsten is mixed with a suitable binder, such as sugar or some other organic substance, and the resulting paste is squirted through a diamond die under great pressure. The moist filament thus formed is then heated in an atmosphere of steam and hydrogen to remove the carbon of the binding material. This treatment leaves a filament of almost pure tungsten. The filament, as mounted in the lamp, consists of four hairpin loops connected in series and mounted upon supporting spires. Connections between the loops are made at the base end of

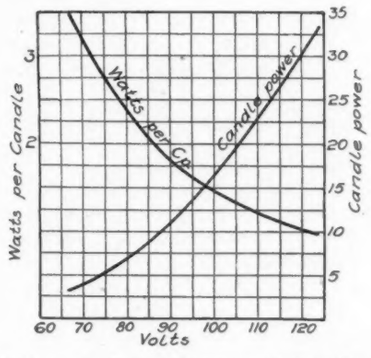


Fig. 3—Variation of Candle-Power and Specific Consumption with Voltage.

the stem by fusing together the filaments and the spires. The filaments are hung loosely on the spires so as to allow for the contraction that takes place after they have been burned for a time.

The shapes of the bulbs and their comparative sizes are shown in Fig. 1. The bulb of the *P* lamp is identical with that on the ordinary 16-cp carbon lamps in use in this country.

The temperature-resistance coefficients of the three types of filaments have large positive values, so that the current at starting is several times as great as under normal operating conditions. Fig. 2 is reproduced from an oscillogram showing the change of current from the instant of starting. The very low resistance when the filament is cold gives rise to a heavy rush

TABLE I.—DIMENSIONS OF FILAMENTS.

Lamp.	Total length, inches.	Diameter, inches.	Total area of surface, square inches.
C	19.87	.00138	.0859
D	15.92	.00202	.1009
P	19.27	.00163	.0987

of current at the first instant which quickly decreases, owing to the rapid increase of resistance as the filament heats up. This rush, when the current is turned on, causes the familiar flash or sudden rise in candle-power above normal, commonly known as "overshooting."

The curves between candle-power and voltage, and between watts per candle and voltage, are shown in Fig. 3. The equation for the former, obtained by the method of least squares is

$$CP = 213.7 \times 10^{-8} \times E^{3.44}$$

Concerning the distribution of light around each lamp, the *C* lamp was found to have the highest tip candle-power, the *P* lamp next and the *D* lamp lowest. The spherical reduction factors of the lamps are shown in Table II.

TABLE II.—SPHERICAL REDUCTION FACTORS.

Lamp.	Mean horizontal candle power.	Mean spherical candle power.	Spherical reduction factor.
C	21.1	17.7	.840
D	22.2	16.2	.730
P	21.9	17.2	.785

In order to make life tests, 50 lamps of each kind were selected for the purpose. Of these, 25 of each kind were oper-

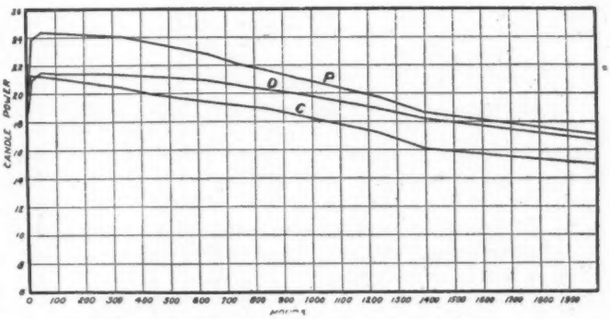


Fig. 4—Average Candle-Power Under Condition A.

ated at a well-regulated voltage, supplied by a storage battery floating across constant voltage mains. The racks holding the lamps were supported by three coil springs in order to protect them from the vibration of the building. This condition was designated as A, and represented exceedingly good operating conditions. The remaining 25 lamps of each kind were operated upon 60-cycle, alternating-current mains having a badly fluctuating voltage. The rack supporting these lamps was rigidly fastened to the floor and received all of the vibration of the building. This vibration was caused by the engines of the University power plant and the machines in the electrical laboratory two floors below. It was great enough to be easily felt by placing the hand on the rack, and the lamps themselves could be seen to vibrate. It was not so severe a vibration as that to which lamps would be subjected in many manufacturing plants, but it was severe enough to represent rather trying operating conditions. This condition was designated as B.

In the life test under condition A, readings were taken up to 2000 hours. At the end of this time there was one *C* lamp, one *D* lamp and 13 *P* lamps still in service. The method of mounting the filament of the *C* lamp is such that it is seldom that a broken filament can be repaired. For this reason, the life curves for this lamp were very uniform, not showing the sudden increases and decreases that occurred in the other lamps. In the *D* lamp the filaments can easily be welded when broken, in fact it is seldom that they could not be repaired after the first rupture.

In the *C* lamp, failures commenced after about 100 hours of use and continued steadily for about 1500 hours, when all the lamps but one were gone. Failures in the *D* lamp began at about 300 hours, and at 1900 hours only one was in service. With the *P* lamp, there was one failure at about 300 hours, and then no more until after 900 hours, when they commenced to fail at the rate of about 1 every 100 hours.

Compared with the results under condition A, those under condition B were rather surprising. The *D* lamp, which made a satisfactory showing under good conditions of operation, did very poorly indeed when operated under adverse conditions. At the end of 600 hours all the lamps were burned out, having an average life of only 153 hours. The *C* and the *P* lamps, as might be expected, gave poorer results than when used under condition A, but gave a much better average life than the *D* lamps, the averages being 434 and 898 hours respectively.

The explanation of the poor life of the *D* lamp under condition B is very simple. These filaments are strung so that they

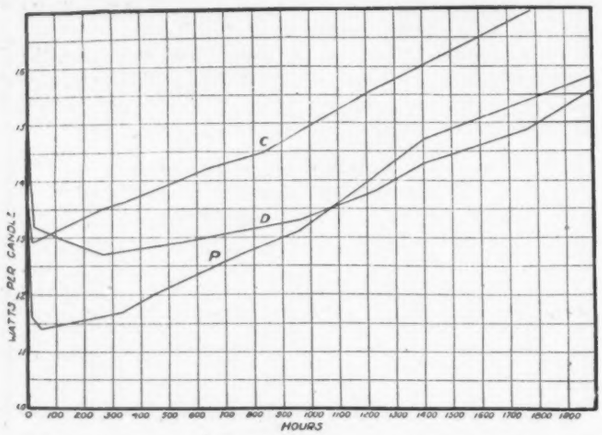


Fig. 5—Average Specific Consumptions Under Condition A.

are under tension and the stem upon which they are mounted is supported between two spiral springs. The object of these springs is to absorb the vibrations to which the lamp may be subjected, but the springs are so strong and the stem itself is so light that instead of protecting the filament from the vibrations, they simply take them up and hold them persistently, and of course set the tightly strung filaments to vibrating also. Often some of the filaments of the lamps under test would be seen to vibrate like a violin string with an amplitude that would occasionally become great enough to allow the two sections of a filament to touch and short-circuit themselves. A slight jar would often be sufficient to start these vibrations. It happens also that the tension, mass and length of some filament sections are such that when burned upon alternating current, persistent vibrations will be set up, due either to the presence of a stray magnetic field or to the magnetic repulsion and attraction action of adjacent filament sections. Upon 50-cycle current, which is common in Germany, where these lamps are manufactured, some filament sections would vibrate strongly when in a magnetic field, though there were fewer that would do so than there were used at a frequency of 60 cycles.

On account of being mounted without tension, the filaments of neither the *P* nor the *C* lamps would vibrate upon either the 60-cycle or the 50-cycle current, unless placed in a strong magnetic field, for instance, between the poles of a horseshoe magnet. When in a strong field, the filaments of both lamps formed a node in the middle and vibrated in two sections. After a long period of service the *P* lamp filaments would sometimes be sufficiently contracted to put some of the filament sections under tension, and then the same persistent vibrations would be noticed in them as in the *D* lamp.

The curves in Figs. 4 to 7 show the changes in candle-power and specific consumption for the three lamps, the curves representing the mean performance of all the lamps tested. All three lamps show the increase in candle-power during the first few hours of burning, and the subsequent falling off in candle-power that is usual with incandescent lamps. The *P* lamp, however, shows the greatest change. It also maintains the highest average candle-power throughout the test, the *D* lamp being next and the *C* lamp the lowest. After 2000 hours' burning, the average candle-power of the *P* lamps decreased to 88

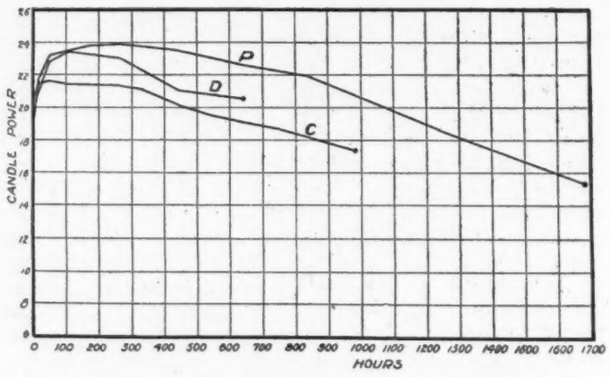


Fig. 6—Average Candle Powers under Condition B.

per cent, the *D* lamps to 89 per cent and the *C* lamps to 77 per cent of the initial value.

The curves of average specific consumption show the *C* lamp to have the highest watt-per-candle consumption throughout the tests. Up to about 1100 hours, the *D* lamp has a higher specific consumption than the *P* lamp, but at this point the curves cross and the *D* lamp has a less specific consumption from that time on. This change in the relative efficiency of the two lamps is due to the greater blackening of the bulb of the *P* lamp.

The *P* lamp shows the most pronounced discoloration, while the *D* lamp shows the lowest. The *P* lamps were decidedly non-uniform in the rapidity with which they blackened. Some of them would be discolored scarcely any after 1000 or 1500 hours' burning, while the others would be so black as to reduce the candle-power by one-third. The *C* and *D* lamps seemed to blacken uniformly, so that at any time all of the lamps of either of these types would be discolored by approximately the same amount.

A summary of the performance of the lamps on the life and specific consumption tests is shown in Table III.

TABLE III.—SUMMARY OF LIFE AND CONSUMPTION TESTS.

Lamp.	C		D		P	
Operating condition.	A	B	A	B	A	B
Average mean horizontal candle-power.						
(*a*) New	19.9	20.6	18.6	19.9	19.9	19.3
(*b*) 1000 hours	18.2	....	19.7	....	20.8	20.6
(*c*) 2000 hours	15.0	....	16.7	....	191	....
Spherical reduction factor	....	.840	....	.730	.785	
Average watts per lamp	27.5	27.4	28.0	28.0	27.7	27.0
Average initial watts per candle-power	1.36	1.36	1.48	1.44	1.32	1.32
Average life in hours	762	434	1167	153	....	898
Average candle-power through life	18.2	20.2	19.5	22.5	20.9	22.5
Cost lamps to run 1000 hours	....	$62.64	....	$220.05	....	$23.80
Cost lamps to run 2000 hours	$70.28	....	$58.05	....	$25.50	....
Candle-power-hours per lamp	36,400	20,200	39,000	22,500	41,800	22,500
Total cp-hours	910,000	505.000	975,000	562,000	1,045,000	562,000
Kilowatt hours	1,375	685	1,400	700	1,385	675
Cost of lamps	....	$1.08	....	$1.85	....	$0.85

On account of the lower cost of lamp and the fewer burnouts, the *P* lamp gives a considerably lower total cost of operation than the other two. The cost of operating the *D* lamp under condition B is excessively high on account of the exceedingly short average life of the lamps under this condition; in fact, for energy costs below 12 or 13 cents per kw-hour, they

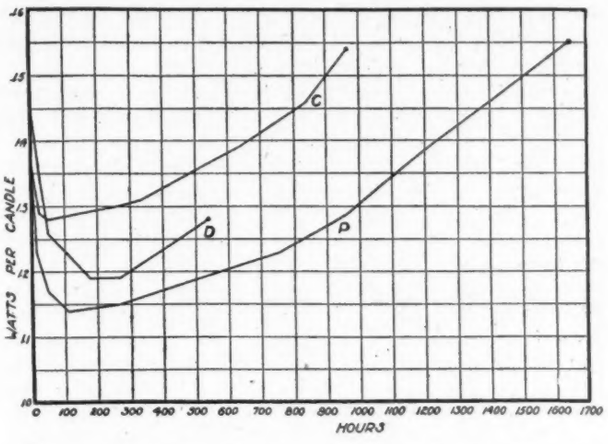


Fig. 7—Average Specific Consumptions Under Condition B.

are more expensive to operate than ordinary carbon-filament lamps.

The above-described tests show that the performance of tungsten lamps may vary to a surprising degree depending upon the kind of lamps used and upon the conditions under which they are used. Some lamps will require as high an operating cost as the old carbon lamps while operating under certain conditions, whereas other lamps will give good results under those same conditions. Under the best conditions, however, the tungsten lamps now on the market give excellent results. Their efficiency is maintained in a remarkable way and the life is very long, often several times what they are advertised to give.

Breakage in shipment and handling have been reduced to a small fraction of what was common in the early lamps. The authors state that only three of the 300 lamps which were purchased for these tests were received with broken filaments, and although the lamps on some of the tests which have been described were handled dozens of times, almost no trouble was experienced with them, so far as the breakage of filaments was concerned.

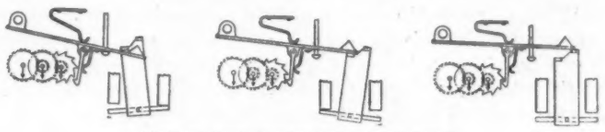
The other defect of the early lamps, that of rapid blackening of the bulbs, seems to have been overcome. Not one of the lamps on the tests showed any early discoloration at all; in fact, not until after about 600 hours of service did any of the bulbs show an appreciable amount of blackening.

NEW TELEPHONE PATENTS.

CALL REGISTERING APPARATUS.

There have been a good many schemes for call-registering apparatus for use at the subscriber's end of the line, but most of these have either required the supply of sufficient current to operate the counting train or else it has been necessary for the subscriber to manually operate the counter.

Mr. D. S. Hulfish, of Chicago, Ill., has arranged a counter which is driven by the switch-hook and controlled by the line currents so that only successful calls will be recorded. The tilting armature of a polarized relay, and the operating arm of the counter are interlocked to form an escapement device. As the armature tilts from side to side following the normal changes of line current, these corresponding to the establishment of a call, the arm rises under the influence of a spring. As it reaches the top of its movement, the fall of the counter latches over a tooth of its train wheel, and almost simultaneously the arm comes up against the head of a link attached to the receiver hook. When this latter is next depressed a count is made. No count is ever made except when the arm has been allowed its full rise, which occurs only after a complete action of the escapement. This consists, first, of a movement in one direction following the response of the operator, and a movement in the reversing direction upon the response of the called party. The response of the called party causes a reversal of the current supply toward the calling party. The whole action may be



Hulfish Call Registering Apparatus.

understood by reference to the illustration. McMeen & Miller have been assigned the patent for this apparatus.

ANTISEPTIC MOUTHPIECE.

Mr. E. T. Evans, of Westerville, Ohio, has patented an antiseptic mouthpiece for transmitters. The mouthpiece proper is an exact duplicate of the standard mouthpiece. Around its base is an annular compartment, within one upper quadrant of which is a curved vial. Its neck protrudes through the wall of the compartment at the top, while a spout projects through the wall of the mouthpiece at its bottom. The axis of this wall is horizontal, and its orifice is closed by a needle valve, the stem of which projects through the opposite wall of the compartment. An absorbent sponge receives the disinfectant as it is discharged from the valve.

TELEGRAPHONE CONTROL SWITCH.

The recording telegraphone of Poulsen has been designed for use as an adjunct to the telephone. When so used, it is essential to get as much of the incoming energy recorded upon the magnetic ribbon as possible. It thus becomes of advantage to cut out the regular receiver. A patent granted to Mr. W. H. Thompson, of Wheeling, W. Va., describes a switch device for accomplishing the desired circuit changes. This switch is mounted upon or near the telephone and has a linkage extending to the switch hook. Whenever the hook is down, the linkage restores the auxiliary switch lever to the normal telephone position. When the hook rises, it releases, but does not propel the auxiliary lever. If the telegraphone is desired for record, the auxiliary lever must be thrown by hand. Then, the cleaning or obliterating magnet of the telegraphone is cut in to prepare the ribbon; the recording magnet is substituted in the telephone set for the receiver and this latter is simultaneously connected to a reproducing circuit so that the record may be heard.

LETTER TO THE EDITOR.

Electrolysis by Earth Currents.

To the Editor of Electrical World:

SIR:—The article by William A. Del Mar in the Feb. 17, 1910, number of *Electrical World*, "Electrolysis by Earth Currents —Reversal of the Conceptions Usually Held," was read with much interest and not a little amusement, especially the latter, for the reason that the writer has always taken for granted the supposedly new theories advanced by Mr. Del Mar, and, moreover, that the action of return current is well known, and that the precautions against electrolysis are easy of accomplishment if the item of cost were eliminated. In a nutshell, the only sure and permanent way to prevent electrolysis of metals buried in the ground or in contact with ground is the non-consideration of such metals as conductors of electric currents. It is conceded that almost any reasonable condition associated with the grounded system can be successfully met, but with the ground return any and all schemes and adjustments are unstable and ever will be; therefore, why not face the music at once and advocate the only certain preventive, i.e., the metallic circuit insulated from ground.

Under the subheading "The Cure for Electrolysis" Mr. Del

Mar states that "Fortunately the drop in the grounded rails may be kept down without an excessive amount of copper. This may be accomplished by means of insulated negative feeders tapped to the rail at intervals, as is done in the New York subways. The drop in these cables may be of any magnitude without affecting the electrolytic conditions, and they may be tapped in at such frequent intervals that the drop in the grounded rails is insignificant."

What is meant by this statement? Surely, the frequent tapping into the rails of an insulated negative return conductor —of either high or low resistance—does not eliminate the rails, earth and other mediums of conductance. The most that would be accomplished is a lowering of the resistance of the negative return; and while this is a step in the right direction, if it be carried to a point where the drop in the negative return is so small as to be negligible, from an electrolytic point of view, then the investment in copper would be greater than would be necessary in the metallic circuit insulated from ground.

On the subject of the earth as a conductor, it would seem that all that is necessary to establish the fact that the earth is a good conducting medium is to demonstrate that it is a conductor, for certainly there is no question of its ample sectional area; this demonstration was made in the traditional past, and the only problem which has confronted the present generation is the medium of contact with the earth. This is a difficult problem, and a successful solution would spell defeat for electrolysis. This same difficulty of connecting to Mother Earth is also responsible for the potential gradient being steep at earth contacts and rapidly flattening out as the radius increases until it finally becomes so slight as to go undetected. In fact, it has always been a pet theory of the writer that the current on entering the earth, having no tag attached, simply crowds a like quantity out at some other point, and goes about its business. This, of course, would only be possible when the total difference of potential between two earth plates is accounted for within a short distance of each plate, as described by Mr. Del Mar. Analogy is responsible for this theory, so that, whether right or wrong, no credit is due.

It would seem reasonable to suppose that in a small town where but a few cars are operated well-bonded rails with frequent connections to water pipes, wherever the latter run parallel to track, would reduce the danger of electrolytic action to a minimum. But in a large city where the rails are used as a conductor, negative copper should be liberal and connections to rails frequent. This can best and cheapest be done by laying the copper with the rails in the form of a trunk feeder and with an auxiliary conductor zigzagging from one rail to the other across the track. This acts as a cross-bond, feeder and connection between main trunk, feeder and track, the track being well bonded, connection to water and other pipes being made only at the source of energy. The only objection to laying the negative trunk feeder with the rails is the danger from electrolysis; but, as the office of the negative feeder is to prevent electrolysis, there is either no danger or else the grounded return system is wrong, and the latter assumption is what this article is meant to sustain.

Sacramento, Cal. E. C. Westcott.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Single-Phase Generators.—C. Pichelmayer.—In some recent large single-phase generators driven by steam turbines, troubles have repeatedly been experienced on account of the burning out of the excitation-winding. This result indicated the occurrence of high voltages. The trouble may be overcome by the method shown diagrammatically in Fig. 1. For the magnet wheel use is made of a drum which is provided with an ordinary direct-current winding for excitation. At two diametrical points, *a* and *b*, the exciting current is introduced, while two other points, *m* and *n* (displaced by 90 deg. against *a* and *b*), are short-circuited. For the excitation circuit the points *m* and *n* have the same potential, so that the short-circuit between *m* and *n* has no effect on the excitation circuit, but it exerts a very pronounced damping effect in another way. If the single-phase magnetic flux is imagined to be resolved into two equal rotary fluxes, revolving in opposite directions, the rotary field which revolves in the same direction as the magnet wheel will be practically at rest with respect thereto. This flux cannot induce any voltages of considerable magnitude. On the other hand, the other rotary flux revolving in the opposite direction may produce dangerous voltages and also distort the current and voltage curves of the generator. The effects of this latter rotary flux are very effectively dampened by means of the short-circuit between *m* and *n*. Oscillograph curves showed a considerable distortion of the wave forms when there was no short-circuit between *m* and *n*, while pure sine waves were obtained as soon as *m* and *n* were short-circuited.—*Elek. Zeit.*, Feb. 17.

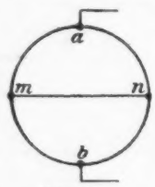


Fig. 1—Single-phase Generators.

Stray Currents in Machine Frames.—L. Adler.—A paper read before the Electrical Society of Vienna. With the aid of diagrams the author discusses the possibilities of a current passing through the axle, the two bearings and the common base plate of the machine. Such currents are observed especially on high-speed machines with few poles. They are due to a lack of symmetry in the magnetic design of the machine. The author reports on experiments and measurements of such currents and discusses means for avoiding them.—*Elek. und Masch.* (Vienna), Feb. 20.

Lamps and Lighting.

Condensers for Metallic-Filament Lamps.—A familiar experiment is to connect an incandescent lamp in series with a condenser across an alternating-current supply system and to measure the voltage across the condenser and across the lamp terminals. A. W. Ashton has recently made use of this experiment for the purpose of reducing the pressure of an alternating-current circuit so that low-voltage metallic-filament lamps can be used. For this purpose a condenser possesses some advantages over an auto-transformer—namely, lightness, convenience and the ease with which metallic-filament lamps of five or even lower candle-power can be used when desired; moreover, a high efficiency is obtained with only one lamp in use, and the no-load losses are avoided. In practice one condenser would have to be used in connection with each lamp installed and it is proposed to design small condensers for use with existing lamp holders and ceiling roses. A condenser for this purpose would cost only a few shillings, and by means of an adapter might easily be fixed by a consumer without the assistance of a wireman. A 5-mf. condenser will allow a 27-watt, 100-volt lamp to be used on a 50-cycle, 200-volt circuit, and the efficiency of the combination will be fully 93 per cent. As is evident from the formula for the current in a condenser connected to an alternating-current supply (namely, current $= 2\pi CE$) the method is particularly well adapted for high-voltage and high-frequency circuits and low candle-power lamps. The fact that the power factor will always be low may possibly not be altogether a disadvantage from the central-station point of view. Where a voltage reduction of 50 per cent is required the power-factor will always be 0.5 and the current 60 deg. out of phase

with the pressure on the mains. As the current leads the e.m.f., however, it will partly compensate for the lagging current due to inductive loads, and will result in the station power-factor being improved. Therefore, condensers possess several attractive features. However, their use is likely to be very restricted, as they cannot compete with an auto-transformer in the case of an installation of more than, say, half a dozen lamps. —Lond. *Electrician*, Feb. 25.

Variations of the Light of Arc Lamps.—E. PRESSER.—While the selenium cell is unsuitable for absolute photometric measurements, it can be used to advantage for determining the variation of the candle-power of a source of light. The selenium cell is lighted by the lamp under test and is in series with a recording milliammeter. Precaution is taken to prevent greater variations of temperature in the selenium cell during the experiment, and in the preparation of the selenium cell care must be taken to make it as free as possible from inertia. The curve given by the recording instrument indicates directly the variation of the resistance of the selenium cell and indirectly also the relative variation of the candle-power of the lamp during the test. Seven such curves determined in this way are shown

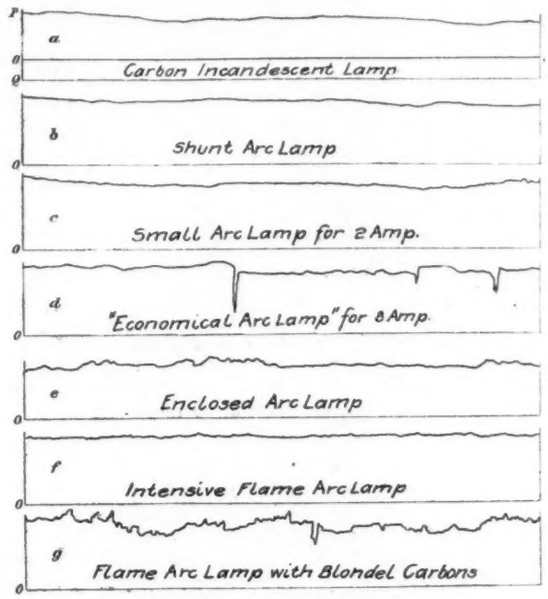


Fig. 2—Variations of Light of Arc Lamps.

in Fig. 2. They indicate the variation of the candle-power of these lamps during one minute.—*Elek. Zeit.*, Feb. 24.

Train Lighting.—J. SEIDENER.—The author emphasizes strongly the necessity of introducing electric lighting on railway trains for the sake of safety. This consideration alone should force railroad companies to introduce electric lighting on their trains. In comparing the cost with gas lighting he finds that if the lamps are used less than 2.3 hours a day, electric lighting is more expensive than gas lighting, but if the lamps are used for longer hours, electric lighting is cheaper. He recommends a system in which each car is equipped with its own generator and battery, and is wired independently of other cars.—*Elek. und Masch.* (Vienna), Feb. 20.

Generation, Transmission and Distribution.

Textile Mill Installation.—An illustrated description of the recent installation of electric driving at the Broughton flax mills in Manchester which were originally designed for belt drive, so that considerable difficulties were experienced in changing to electric drive. The spinning frames are driven in groups of from 15 to 20 by 60-hp, direct-current motors suspended from the ceiling and driving through chain gear. The latter was adopted after an unsuccessful trial with spur-gearing, there being no space for a rope or belt drive. The motors are of a special construction, which permits of easy erection even under the unfavorable conditions of the case in question.—Lond. *Elec. Eng'ing*, Feb. 24.

Installations, Systems and Appliances.

Condenser Water Cooling at Central Station.—An illustrated description of the plant which has been erected at the Salford electricity works in England at a total cost of over $60,000 for cooling the condensing water. Seven hundred and fifty thousand gallons of water have to be circulated per hour at full load. The hot water from the condensers is pumped out of the hot well by four turbine pumps driven by 60-hp, direct-current motors into a common pressure main from which it is distributed to four cooling towers of the natural-draft chimney pattern. In these towers the water is cooled from 90 deg. Fahr. or 100 deg. Fahr. to 65 deg. Fahr. The cooling apparatus proper is built into the lower part of the tower, and consists of wooden distribution troughs, splash plates and cooling hurdles, by which the incoming warm water is divided up into minute drops and brought into the closest possible contact with the air entering from below. The cooling effect is obtained partly by evaporation and partly by conduction of heat to the air. Each tower is 75 ft. in height, and the water is delivered into the tower at a point some 22 ft. above the bottom of the tank, the remaining 53 ft. of chimney providing the necessary draught.—Lond. *Elec. Eng'ing*, Feb. 24.

Balancers.—A. G. COPPER.—A long illustrated abstract of his recent paper on balancers for three-wire systems, a short abstract of which was recently noticed in the Digest. An account of the discussion which followed is also given.—Lond. *Electrician*, Feb. 25.

Tax on Electricity.—H. SCHREIBER.—With reference to recent legislation in Germany and Austria, the author discusses critically what he considers the disadvantage and unfairness of a tax on electricity and on lighting.—*Elek. und Masch.* (Vienna), Feb. 13.

Transportation of Coal.—H. HERMANNS.—An illustrated description of the coal transportation facilities of the central station of Reisholz.—*Elek. und Masch.* (Vienna), Feb. 13.

Wires, Wiring and Conduits.

Overhead Line Construction.—W. B. WOODHOUSE.—A paper read before the Leeds Section of the (Brit.) Inst. Elec. Eng. After referring to the onerous conditions imposed by the British law on the erection of overhead lines, the author discusses the design of overhead conductors (copper and aluminum), poles, flexible supports, etc. As to the economical span he points out that if the number of supports per mile is decreased the poles must be stronger and longer. The brackets, arms, insulators, etc., must be stronger, and the labor of erection per pole is increased. Against this increase per pole must be set a decreased number of supports. It is stated that the strength of the poles, allowing for increased height with increased span, is approximately proportional to the fourth power of the butt diameter (D^4), and the cost of wooden poles of lengths between 30 ft. and 60 ft. is proportional to D^3. The ratio of cost of poles per mile of line under these conditions is, therefore,

$$\frac{\text{Cost with span } s}{\text{Cost with span } s_1} = \frac{\sqrt[4]{s_1 s^3}}{s_1}$$

which is to say, that if the span is doubled the cost of the poles will be increased in the ratio of 1.67 to 1. The number of poles being decreased, the total labor cost is decreased also; but, as each foundation will prove more costly, not to the same extent. The decrease in the number of poles will also decrease the cost of right-of-way, and, taking all the items into consideration, a balance may be struck. In practice, one finds that over a considerable range of span variation the cost is fairly constant, and the actual span length is determined by local conditions.—Lond. *Electrician*, Feb. 25.

Design of Lines.—H. MAGRON.—Blondel has devised a graphical method which permit the direct determination of the tension and sag of a line as functions of the distance between poles and variations of the temperature. Blondel has also

shown how to modify this method so as to employ the same diagram for metals of different specific gravity. The present author shows how it can be modified so as to apply also to the most general case of metals of different coefficients of elongation and elasticity coefficients.—*La Lumière Elec.*, Feb. 15.

Lead Joints.—An illustrated note on a new system of lead jointing, which has been introduced for the plumbing of lead-covered cables and other lead joints. A low temperature weld of the two surfaces to be jointed is produced by inserting a piece of prepared tin-foil between them and heating with a blow-torch.—Lond. *Elec. Eng'ing*, Feb. 24.

Electrophysics and Magnetism.

Alternating-Current Theory.—C. Breitfeld.—An article discussing the best method of teaching the theory of cyclic magnetization in the case of an alternating-current circuit with an iron core.—*Elek. und Masch.* (Vienna), Feb. 6.

Thermodynamics.—W. S. Franklyn.—A discussion of the second law of thermodynamics, its basis in intuition and in common sense. The author brings out strongly the principal feature of the second law of thermodynamics (as a law of waste instead of conservation) and explains the meaning of thermodynamic degeneration by different very simple illustrating examples.—*Popular Science Monthly*, March.

Spectrum Tubes for Direct Current.—H. Konen and W. Jungjohann.—An article on the construction of Geissler tubes for operation with direct current for various quantitative measurements.—*Phys. Zeit.*, Feb. 15.

Magnetization Curves of Small Wires.—J. A. Veazey.—An account of experiments the object of which was to obtain a number of magnetization curves for a sample of 1-mil iron wire, and from the curves to determine something in regard to the relative magnitude of the molecules, or groups of molecules constituting the elementary magnets of which a large magnet has been thought to consist. The argument is that if the magnetization curves showed changes indicative of sudden changes of magnetic flux in the wire, the inference would be that the groups are of the order of the 1 mil in magnitude. If the magnetization curves are smooth, the inference is that the groups are less than 1 mil in order of magnitude. Since by the best methods available the curve found by the author is perfectly smooth, it is concluded that the elementary magnets of whatever kind they may be are less than 1 mil in order of magnitude.—*Phys. Rev.*, February.

Hysteresis Loss.—W. P. Fuller and H. Grace.—A paper read before the (Brit.) Physical Society on the effect of temperature of the hysteresis loss in iron in a rotating field. The effect of increasing the temperature of iron is a reduction of the hysteresis loss at a given induction.—Lond. *Electrician*, Feb. 25.

Electrochemistry and Batteries.

Effect of Pressure and Temperature on Electrolytic Rectifiers.—A. P. Carman and G. J. Balzer.—An abstract of a Physical Society paper. A large number of oscillograph curves were photographed of the alternating current through different electrolytic rectifiers at pressures from 15 cm of mercury up to 21 atmospheres and at different temperatures. These curves show that at the higher pressures the rectifying property decreased so that at 21 atmospheres a cell with aluminum-carbon electrodes and alum for electrolyte showed about half rectification. The property of rectification was regained when the pressure was reduced. Increase of temperature is also shown to act similarly to increase of pressure, but the cell does not recover its rectifying properties when the temperature is lowered again. Observations were also made on the deposits formed on the electrode. The bearings on the theories advanced were briefly discussed. Slides of the oscillograms and readings of currents and electromotive forces were shown.—*Phys. Rev.*, February.

An Electrolytic Phenomenon.—H. W. Morse.—An abstract of a Physical Society paper on some minute phenomena of electrolysis. If pure water is electrolyzed between silver electrodes of small area at an e.m.f. of from 1.5 volts to 2.5 volts, no gas appears at the electrodes. Instead, a cloud is sent out from the anode and this moves along the current lines to the cathode, where metallic silver begins to separate. Very slight quantities of electrolytes prevent the phenomenon completely, as low as 0.0003 normal for some salts. The cloud appears to be made up of approximately spherical particles, probably of silver oxide, in rapid Brownian motion. On coagulation, the particles collect in bunches which are frequently symmetric along three axes.—*Phys. Rev.*, February.

Aluminum.—P. Roland.—The conclusion of his article on the present commercial status of the manufacture of aluminum and its industrial application. Figures are given on the change in the price of the metal from year to year, the consumption of aluminum in France, exports from France, and a list of the French plants making aluminum. They have at their disposal an aggregate of 140,000 hp.—*La Lumière Elec.*, Feb. 19.

Units, Measurements and Instruments.

Recording Frequency Meter.—O. Martienssen.—While the tuning-fork frequency meters as devised by Frahm and others are very useful as indicating instruments, they cannot be made recording. A new recording frequency meter of the Siemens &

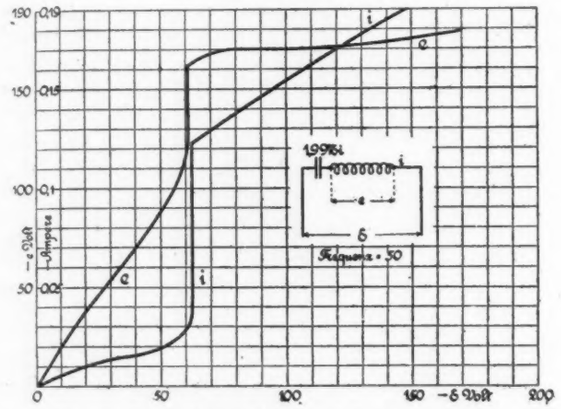


Fig. 3—Connection and Test of Frequency Meter.

Halske Company is based on the following principle. A small induction coil with a closed magnetic circuit of iron is connected in series with a condenser, and the induction coil and condenser are connected across the two conductors of the line, the frequency of which is to be determined. Under certain conditions the voltage at the terminals of the induction coil

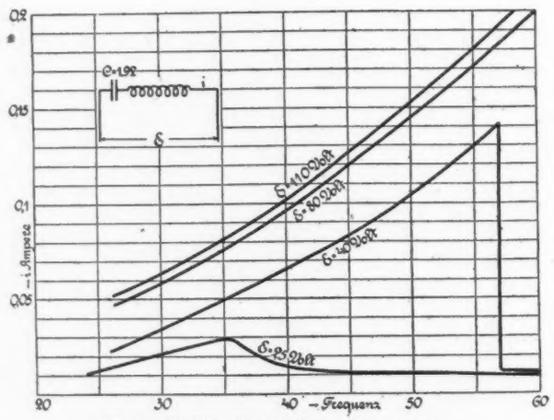


Fig. 4—Calibration of Frequency Meter.

will then become almost independent of the voltage across the conductors of the line, but will depend on the frequency. When an ordinary voltmeter is connected to the terminals of the induction coil, it can be used as a frequency meter and its indications will be independent of the wave-form of the current and of the variations of the voltage across the conductors of the line. Fig. 3 gives the results obtained with an actual in-

strument. The abscissas are the voltage E across the conductors of the line or of the machine which gives the current during the test. The ordinates of the curve i give the current and the ordinates of the curve e give the voltage at the terminals of the induction coil. When the e.m.f. E between the terminals of the generator varies between 80 volts and 130 volts, the voltage e at the terminals of the induction coil is practically constant, while within these limits the current increases proportionally to the voltage E. Fig. 4 gives the relation between the frequency (abscissas) and the current i in amperes (ordinates). The different curves refer to different voltages of the generator. The curves for 80 volts and for 110 volts at the terminals of the generator are almost the same. Commercial recording frequency-meters of this type are made for 110 volts and for from 40 cycles to 60 cycles.—*Elek. Zeit.*, Feb. 24.

Recording Instruments.—K. PERLEWITZ.—An illustrated description of various improvements of recording measuring instruments of Siemens & Halske Company, including direct-current ammeters and wattmeters and alternating-current instruments. In such cases where it is not desired to record all little details of the curve but to obtain rather an average curve, a special oil-damping device is employed which is illustrated in Fig. 5. It combines the advantages of small masses and frictionless adjustment of the recording lever with a strong damping effect. The oil is filled in before the instrument is shipped, and will not run out of the narrow glass tube which

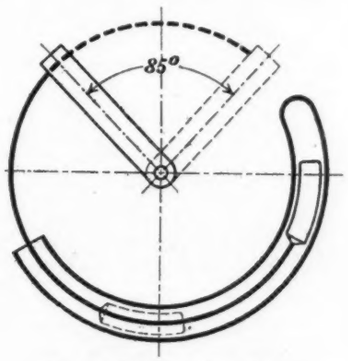


Fig. 5—Oil Damping Device.

is closed at the other end. Recording pyrometers and recording resistance thermometers for plotting the fever temperature variations of sick people are also described, as are also time-recording instruments, etc.—*Elek. Zeit.*, Feb. 17.

Electric Time Service.—F. HOPE-JONES.—The conclusion of his illustrated paper read before the (Brit.) Inst. Elec. Eng. on modern systems of electric time service.—Lond. *Electrician*, —Feb. 25.

Temperature Conversion Table.—L. WALDO.—A convenient table for conversion of Centigrade and Fahrenheit degrees of temperature, extending from the temperature of liquid air to that of the arc.—*Met. and Chem. Eng'ing*, March.

Telegraphy, Telephony and Signals.

Automatic Telephone Exchange.—P. HILDEBRAND.—An article on automatic telephone exchanges in general, and especially the exchange in Munich-Schwabing (a suburb of Munich), which is connected to an automatic exchange, while Munich itself has retained the old telephone system. The author describes briefly a new system devised by himself. The principal feature is that there is no series connection of several subscribers; every subscriber has his own connection in the exchange.—*Elek. Anz.*, Feb. 24.

Impact Excitation of Undamped Electric Oscillations.—G. W. NASMYTH.—An abstract of a Physical Society paper. The Lepel singing arc, which differs from the Duddell and Poulsen arcs chiefly in the use of very short arc lengths, obtained by placing a few sheets of paper between flat-metal electrodes, affords a means of producing high-frequency oscillations of considerable power which are only slightly damped. Its origin goes back to the discovery by Wien in 1906 that for small spark-lengths of about 0.15 mm a third maximum appears between the two resonance frequencies usually encountered in coupled

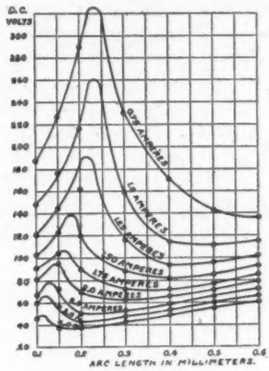


Fig. 6—Form of Curves.

circuits. This third maximum is higher than the other two, and its frequency corresponds to the natural frequency of the antenna, or secondary of the coupled circuits. According to the theory of impact excitation ("Strosserregung"), the third wave is explained by the rapid recovery of the resistance of short gaps, so that the oscillations in the primary are extinguished after they have given up the greater part of their energy to the secondary circuit. The oscillations in the secondary then continue as if it were an isolated circuit with its own natural frequency and damping factor. The author's experiments indicate that the phenomena cannot be completely explained by the rapid recovery of resistance in the arc due to its short length alone. The form of the curves shown in Fig. 6, which give the potential difference indicated by a direct-current voltmeter across the arc when the current is kept constant and the arc length varied, demonstrates the presence of a resonance effect. The capacity of the arc, which at short lengths is about equal to that of a Leyden jar, makes it possible to have oscillations set up through the choke coils and generator in the main circuit, and the relation of the frequency of these oscillations to that of the oscillation circuit determines the number and character of the discharges through the arc. Curves similar to those given in the illustration can be obtained at longer arc lengths if a variable capacity is placed in parallel with the arc, and it may be possible in this way to obtain impact excitation with spark gaps of the usual lengths, and with the Duddell singing arc. Although the Lepel arc is in some respects similar to a spark gap, it resembles the singing arc more closely in the large number of harmonics present, and in its frequency characteristics. The frequency, as determined by a loosely coupled resonance circuit, increases with the arc current; it also decreases with increasing arc length.—*Phys. Rev.*, February.

Oscillator.—J. E. IVES.—An illustrated account of experiments the object of which was to determine the wave length of the electric waves emitted by linear oscillators. By a linear oscillator is meant an oscillator of cylindrical form, the diameter being small compared with the length. Two theories exist today as to the wave-length of such an oscillator. One theory due to Abraham reaches the conclusion that the wave-length is equal to about twice the length, and the other, due to Macdonald, that it is equal to about two and a half times the length of the linear oscillator. The results obtained by the author appear to agree with Abraham's theory rather than with Macdonald's.—*Phys. Rev.*, February.

Directive Wireless Telegraphy.—L. H. WALTER.—An article illustrated by diagrams on the radiation from directive aerials in wireless telegraphy. The author deals with the question of dirigibility in the emission of electric waves for wireless telegraphy, taking into account the methods of Artom and of Ballini and Tosi. He then gives the results of an examination of the radiation which could be expected from a single aerial of this

type under various conditions, and shows by examples that the electrical method of changing the direction of the emission maximum put forward by Artom is of no practical value—Lond. *Electrician*, Feb. 25.

Poulsen Arc.—W. E. Story.—An account of various experiments with the Poulsen arc with a critical discussion based on a mathematical theory. The most interesting result appears to be that within the limit of error of the experiment the current in the Poulsen arc as used by the author is of a simple sine form, being a simple harmonic vibration, since otherwise the results of the experiments would not have agreed with the theory.—*Phys. Rev.*, February.

Wave Detectors.—K. Bangert.—A critical systematic review of the properties of the most important different types of wave detectors for wireless telegraphy. The article is illustrated by numerous diagrams.—*Phys. Zeit.*, Feb. 15.

Wave Receivers.—H. W. Webb and L. E. Woodman.—A critical comparison of the different electric wave receivers for the study of short electric waves.—*Phys. Rev.*, February.

Miscellaneous.

Thunderstorm Electricity.—W. W. Strong.—An abstract of a Physical Society paper. In a recent discussion Simpson has shown that for three reasons the Wilson-Gerdien theory is incapable of explaining the origin of thunderstorm electricity. The most important difficulty is that the rate of ionization in the air is not great enough to account for the rapid production of lightning flashes. During the past summer it was found that the rate of leak of closed electroscopes was increased many times by removing them from the warm surface of the ground to a cool cave. This effect took place only when the weather was very warm. The effect was found for some eight electroscopes, one of which was arranged so that the electrode above the sulphur insulation was at a higher potential than the gold leaf. This relation insured that the effect was not due to a leak over the insulation. The effect was not due to a penetrating radiation, and can hardly have been due to the formation of an active deposit on the walls of the electroscopes. If the increased rate of leak was due to an increased ionization in the electroscopes, then the change is very similar to that which would take place when surface air is rapidly carried into upper regions of the atmosphere during thunderstorms. Such a large increase in ionization would remove one of the serious difficulties of the Wilson-Gerdien theory. Recent work by Simpson indicates that the breaking of raindrops probably causes a considerable part of the separation of positive and negative electricity during thunderstorms. But it also seems possible that the condensation upon negative ions may also cause the separation of electricity. These ions may carry several changes and thus cause a greater separation. Simpson only considers negative ions to carry a single charge. It would be interesting to know whether the supersaturation necessary for condensation on negative ions is dependent on the size of the charge they carry.—*Phys. Rev.*, February.

Italian Electrical Association.—A review of the proceedings of the thirteenth Congress of the Italian Association of Electrical Engineers, held in Brescia at the end of September, 1909. President Lombardi, of the association, gave a review of recent progress in electrical engineering. Riccardo Arno read a paper on new methods of industrial measurements for alternating-current distribution systems. C. Rossi spoke about the production of nitric acid from air, Piola on alternating-current electrolysis in a magnetic field, A. Tosi on the determination of the direction from which a wireless-telegraph station sends signals, R. Vallauri on graphical methods in the calculation of electric traction projects, G. Vallauri on hysteresis in rotary magnetic fields, Revessi on the electrification of railways by the single-phase system. Excursions were made to different plants.—*La Lumière Elec.*, Feb. 19.

New Apparatus and Appliances

RECIPROCATING METER.

Fig. 1 herewith illustrates a meter for registering the total travel of reciprocating motions, making it suitable for pumps, engines, elevators, etc. The device is particularly useful for determining the actual life of different piston rings, packings, pump valves, lubricants, elevator cables and other appliances used on reciprocating machinery, as well as the amount of energy consumed where the duty performed is constant. The

Fig. 1—Reciprocating Meter.

application of the meter to a pump is shown in Fig. 2. A flexible bronze cable ⅛ in. in diameter is fastened to the drum on the meter and connected at the other end to the cross-head of the pump which may have any diameter and any stroke up to 48 in. The meter is equipped with a spring return operating on the principle of a steam-engine indicator. The spring is made of phosphor bronze. The dotted circles indicate other locations for the meter which may be used either right-hand or left-hand with lead of rope from either top or bottom of the drum. Any number of fractions of a stroke in either direction are added and recorded by the main dial, which always rotates in a clockwise direction, one complete revolution representing 10 ft. of total piston travel. The reading is indicated to 1/20 part of a foot. The row of numerals at the bottom gives the total lineal feet traveled. This row of numerals repeats at 100,000,000 ft. For strokes longer than 48 in. a traction device of three pulleys is employed. The instrument can also be arranged for a positive return, the spring in this case being removed from the back of the meter. A second cable is led over the top of the drum to a small stationary wheel secured to the pump, engine, etc., and passing

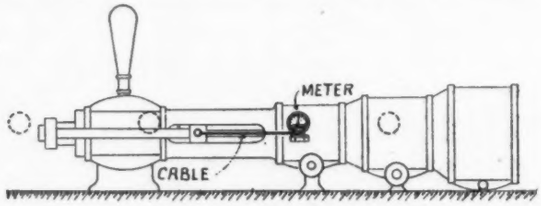


Fig. 2—Meter Attached to Pump.

under the wheel is fastened to the cross-head by a small spring to keep the proper tension on the cables. One cable unwinds on the drum while the other winds in the same grooves.

A sectional plan view of the meter is shown in Fig. 3, the meter being equipped with the spring return attachment. Back of the grooved drum around which the cable is wound is a box

6 in. in diameter. This box contains a tempered phosphor bronze spring 1 in. wide by 16 ft. long, with its outer end fastened to the box and its inner end to a collar forced against the drum by a nut on the end of the shaft, the spring and drum thus moving together. To the shaft is keyed a ball clutch *B*, one side of the face gripping the under side of the gear *A*, and the other, the gear *D*. The clutch has rollers *C* (three on each side equally spaced, but staggered with reference to one another) that are forced out into a wedge-shaped race by plungers with springs behind them. The gears *A* and *D* mesh with pinions *E* and *G*, which also mesh with each other; thus the two pinions and the two gears are always running together in the same direction. The shaft of pinion *G* drives the clock mechanism which indicates the distance the cross-head has traveled in feet. When the drum turns in one direction (which is accomplished by one end of the cable being fastened to the drum and the other to the cross-head) the clutch, by means of the rollers will grip the shoulder of the gear *A*, turning it in the same direction, while gear *D* is running free in the opposite direction. On the reversal of the drum, caused by the change in the direction of the stroke of the cross-head, gear *D* is gripped and gear *A* runs free.

From the readings in lineal feet the actual number of gallons of water and the volumes of gas delivered by pumps and com-

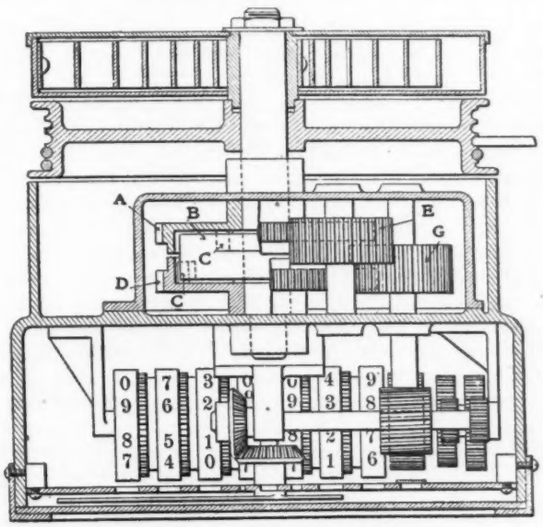


Fig. 3—Sectional Plan View of Meter.

pressors can be calculated. This is important for boiler-feed pumps where an accurate record can be obtained for the maximum weight of water or gallons evaporated per pound of fuel. On duplex pumps, the meter shows which side is traveling the greater distance or is doing the most work and gives notice if the valves have not been properly set. In determining the competency of an elevator operator, for instance, where electricity is used as the motive power, the instrument may be used to advantage. A good elevator operator will aproach a landing and stop without going beyond the floor level. A poor operator will go beyond the floor and then reverse and in one or two attempts manage to bring the elevator even with the landing. The starting of the elevator under such conditions requires an excess of energy. The elevator shafts being of a known height, the travel in feet or miles per 100 trips should be constant, or very nearly so. By comparing the travel, as recorded on a meter of this type of the various elevators in a building, the incompetent operators, those who go by a floor and then return in an attempt to stop at the landing, are quickly identified. The complete equipment comprises one meter proper with spring complete; one reserve main phosphor bronze spring; one coil of ⅛ in. diameter flexible bronze cable 30 ft. long; four small brass cable lamps; two back tension springs, one reserve; one stationary wheel with stand complete for positive drive, and one pipe collar in connection with positive drive. The device is made by the Mechanical Instrument Company, 120 Liberty Street, New York.

SANTA FE TELEPHONE DISPATCHING SYSTEM.

The Santa Fé System has extended the use of the telephone for train dispatching over its road from Denver to Pueblo, Col. Telephones have been installed over approximately 1950 miles of the Santa Fé lines, and it is planned to extend the equipment on other sections of the road as soon as possible.

There are about 40 telephone stations on the 120-mile stretch between Denver and Pueblo, and here telephone equipment and Gill selectors, supplied by the Western Electric Company, have lately been installed. Over this single-track division there are in the neighborhood of 25 to 30 trains a day, and in the handling of these trains there are approximately 75 regular meeting points. It is estimated that the installation of telephones on this division will enable the dispatchers to handle the same amount of work as previously in about 60 per cent of the time.

MEETING OF TECHNICAL PUBLICITY ASSOCIATION.

The Technical Publicity Association had its regular monthly meeting and dinner at the National Arts Club, in New York, last week, with Mr. Frank H. Gale, of the General Electric Company, presiding. Mr. Converse D. Marsh, of the Bates Advertising Agency, delivered an interesting address on methods of securing a correct idea of the cost and inquiries, and Mr. A. C. Harn, advertising manager of the National Lead Company, took part in the discussion that followed. President Taft's recommendation for an increase in second-class postage rates was the subject of a joint debate in which Mr. Charles E. Carpenter, of E. F. Houghton & Company, Philadelphia, took the affirmative side of the question in an unusually able and interesting paper supporting President Taft's position. Mr. Charles T. Root, of the Root Newspaper Association, took the other side and in a very forceful and logical manner defined the position of publishers with regard to proposed increased rates of postage, pointing out in some detail the injurious consequences which would result to newspaper, magazine and periodical publishers and their readers and advertisers.

CUTLER-HAMMER ANNUAL DINNER.

At the second annual dinner of the staff of the Cutler-Hammer Manufacturing Company at the Milwaukee Club, in Milwaukee, recently, there were several bright entertainment features. The souvenirs of the affair, containing the menu, dinner cards and the original verses that were sung, was issued in the form of a regular catalog bulletin by Mr. C. L. Benjamin, advertising manager of the Cutler-Hammer company, and is a clever production.

The menu is given on one of the regular order blanks of the company and directs the steward of the Milwaukee Club to ship to Mr. A. P. Munning, private dining-room, Milwaukee Club, Milwaukee, Wis., via quickest route, certain materials, both dry and liquid, which are set forth in the formal list. This bears the signature of the purchasing agent of the company. The dinner card, showing where the different gentlemen sat at the table, represented by an emblem of some piece of electrical apparatus each of the persons indicated. Thus Mr. F. R. Bacon, the president, is shown by a generator; Mr. F. L. Pierce by the main-line switch; Mr. A. W. Berresford by a self-contained controller with the lid off, and so on. Many of these conceits were amusing. The booklet contains five stanzas written by Mr. Charles L. Benjamin, entitled "Our Ancient Lineage," which cleverly trace in detail the evolution of the electrical engineer.

WESTERN ELECTRIC FANS.

To meet the requirements of ventilation by means of portable fans the Western Electric Company has, besides the fans which have been offered in previous years, developed several new types, as shown in the accompanying illustrations. The present line of fans for the season of 1910 includes fans for all conditions of service and for operation on all commercial circuits.

In order to meet the growing demand for small and oscillating fans the line in these fans has been considerably increased. The oscillating alternating-current and direct-current fans are of the desk and bracket design, and both wind and mechanically operated. The mechanically operated oscillating fan is arranged so as to be readily used for either desk or bracket purposes, without an adapter.

A new type of telephone booth fan has been designed with three operating speeds. It is especially arranged to operate noiselessly, and, as seen in the photograph, provision is made for the absorption of all vibration. The motors of the fans

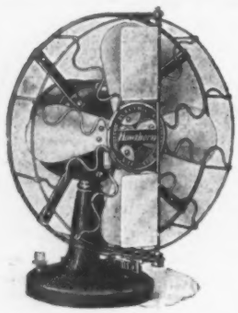


Fig. 1—Oscillating Fan.

Fig. 2—Telephone Booth Fan.

are furnished to operate on either an alternating-current or direct-current circuit.

The desk type of the fans in 8-in., 12-in. and 16-in. designs are adjustable for use either as desk or bracket fans and operate on several voltages. The 8-in. fans are very attractive and

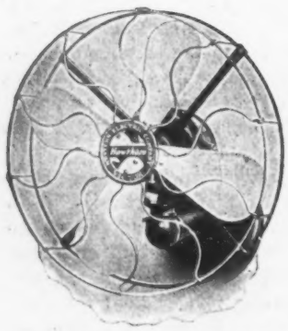


Fig. 3—Desk or Bracket Fan.

Fig. 4—Counter Fan.

especially adapted to small offices and homes. Like the larger sizes, they are operated at three speeds and on various voltages.

The slow-speed desk fan is provided with six blades and operates at from 950 r.p.m. to 1060 r.p.m. This fan is especially adapted to residences.

The floor, counter, column and ceiling fans are designed for both direct-current and alternating-current circuits in three speeds.

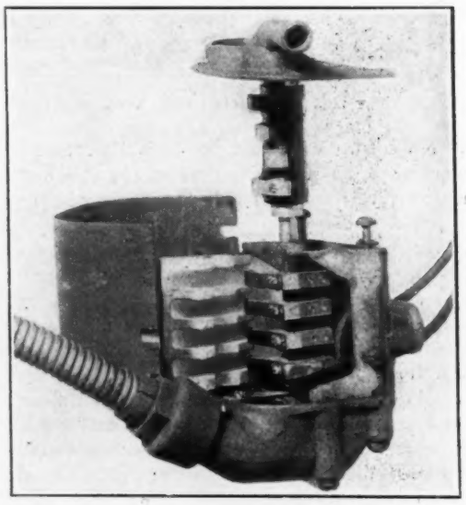
CONTROLLER FOR COAL PUNCHER.

In order that men operating coal punchers in which the air is compressed by an electric motor and used immediately at the face of the coal may maintain a constant number of strokes per minute, there must be provided some means for regulating the voltage at the motor, for in any mine equipped with direct-current apparatus there is sure to occur variations in voltage due to fluctuations of load because of the operation of haulage locomotives, pumps, etc. As is true in other kinds of electrical work, such as electric locomotives, this regulation is accomplished by means of a controller with which resistors may be thrown in or out of the circuit at the motor, thus increasing or decreasing the voltage.

To produce a controller within the limited space available and one that would operate successfully under the conditions of coal mining, has been difficult heretofore, but the cylinder magnetic blowout, illustrated herewith, is said to meet the conditions satisfactorily. The controller is of a type commonly used with electric locomotives, street-railway equipments, etc., but it is of miniature size. The contact cylinder, arc divider, magnetic blowout, fingers with removable contact and removable hood are included, and each part has been so carefully designed and constructed of selected material that the apparatus is now well adapted to the service.

In order to increase or decrease the resistance the lever, with which is obtained three speeds, is provided with a spring which rests in notches at the proper points for contact in the same manner as in larger controllers. A two-conductor cable, which carries energy to the coal puncher, is supported on a reel conveniently placed at the face of the coal. From the reel the cable is drawn out to the room neck where the terminals are attached to the permanent wires in the entry. From the reel connection is made by plugs, one in each end of the reel hub which connects directly with the controller, and the other from the rheostat from which it completes the circuit to the controller by means of the different contacts operated by the lever. Four conductors lead from the rheostat to the controller, so that the resistance of the rheostat is divided into three sections determining the three speeds.

In construction the resistor is thoroughly protected against



Interior View of Controller.

injury due to dampness and to withstand the severe service required of mine apparatus. It consists of coils firmly mounted on supporting frames held rigidly in position and surrounded by a cylindrical metallic covering. Each controller and resistor is fully tested before shipment, the test for insulation being at 1100 volts alternating. The above described controlling device has been placed on the market by the Pneumelectric Machine Company, Syracuse, N. Y.

AUTOMOBILE ELECTRIC LIGHTING.

For the lighting of automobiles with electric lamps two systems may be said to be giving satisfactory service; the first, which may be called the straight storage, has for its foundation a special lighting battery of large output and high discharge rate. This battery can be charged at any garage having proper facilities and will operate two head lamps and regulation side and tail lamps for from three to five weeks, depending on the size of the battery and the number of hours of continuous use of lamps.

The electric generator system, which is the straight storage system plus a battery-charging generator, operated while the car is in motion, provides a constant source of energy which is stored in the battery, and which in turn acts as a distributor and insures a uniform voltage at the lamps. The latter system makes possible the use of one central source of electrical energy (namely, the generator) and one receptacle where this energy is stored, and from which energy is distributed for everything electrical about the car in regular service in addition to providing a reserve for use when the generator is not running.

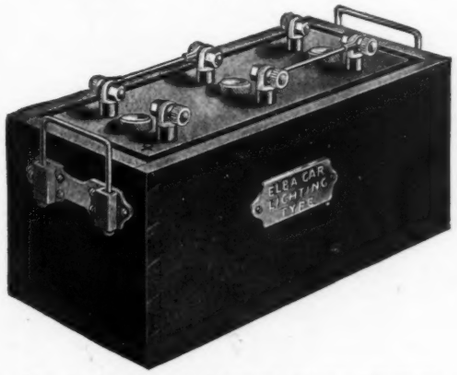


Fig. 1—Automobile Lighting Storage Battery.

At present many cars are equipped with a magneto for regular ignition, dry cells or storage batteries for starting, two systems for lighting, in some cases three, and it would seem that one storage battery might be used to distribute energy for regular ignition, for starting, for operating a signal horn, for operating head lamps, side lamps, etc., thus doing away with a number of unrelated appliances.

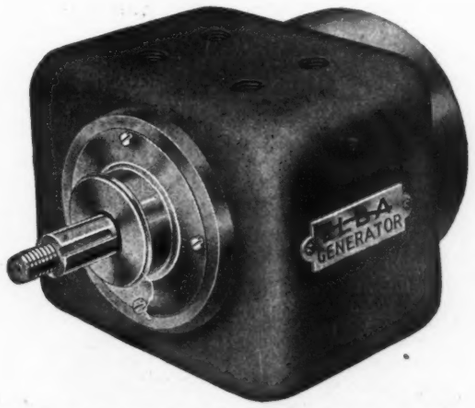


Fig. 2—Automobile Battery-Charging Generator.

When the car is in regular service, energy is constantly put into the battery and by the use of proper batteries with the system the danger of their being overcharged, should lamps not be used, is removed. To prevent the battery discharging itself through the armature windings where the car is not in motion, an automatic cut-out is provided to disconnect the battery from the generator when the car speed is reduced to about six miles per hour.

In the Elba system developed by the Willard Storage Battery Company, Cleveland, Ohio, the generator, battery, tungsten lamps and automatic cut-out form a complete Pullman car lighting system in miniature. When the car is standing the lamps receive energy directly from the battery.

The severe conditions of automobile service demand great stability and to this point special attention has been given in the construction of every detail of the system. The record of tungsten low-voltage lamps during the past two years has thoroughly demonstrated that they will withstand vibration and their life is long enough to make electricity more economical than gas. In the 6-volt system, lamps ranging in candle-power from 2 to 30 can be used.

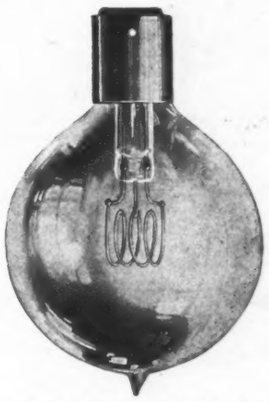


Fig. 3—Automobile Electric Lamp.

The generator used in connection with the battery removes the objection of unreliability and makes possible the use of many other electrical appliances, such as signal horns, cigar lighter, reading lamps, fans in limousines, etc.

The generator maintains a constant current, regardless of the engine speed, its output being suited to the discharge rate of the battery, so that if lamps are not used there is no danger of the battery being injured by continuous charging.

To the tourist, the certainty of having energy always on hand is a first consideration. This point is covered by the battery being made very large, and should the generator be out of commission, it is said that the battery would furnish energy for at least a week's ordinary running.

TELEPHONES FOR MINE SERVICE.

The prevention of loss of life from fires in mines has become imperative. The most practical safeguarding measure that has been advanced by authorities on the subject is a systematic use of the telephone. The usefulness of telephones in mines is by no means a new subject for discussion. Many mines already have working telephone systems both above and below ground, and it facilitates their business as well as provides a means of safety in case of accident.

The accompanying illustrations show a design of mine telephones recently completed by the Western Electric Company, the development and reconstruction of which have covered a period of several years of close co-operation with mine operators and officials, with the idea of making the new design cover all the requirements of mining service.

The illustrations in Figs. 1, 2 and 3 show views of what is known as a metal-type mining set.

All of the parts which for any reason need to be removed can be easily taken out of the sets without the aid of a soldering iron, as all the connections are made with suitable screws. Although it is not necessary to get into the working parts of the apparatus except for changes to the system this feature makes the system available for inspection at any time.

The top of the set is curved so that any foreign articles or water falling on it will readily run off.

The line wires to the sets may be brought in either at the top

of the box or at the bottom. When brought in at the top the curved connector shown at the top of the box in Fig. 1 is used. This connector, it will be noted, prevents moisture or water from running into the set when the wires are led into the top of it.

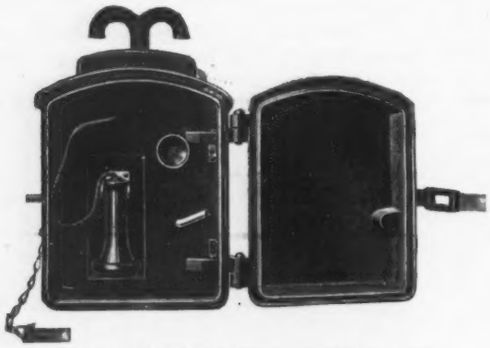


Fig. 1—Mine Telephone Ready for Use.

It will be readily seen that as the wires come down to the set and make the turn into the curved connector any moisture or water will drop from this point and not follow the wire into the apparatus.

When the line wires are brought in from the bottom, it is not

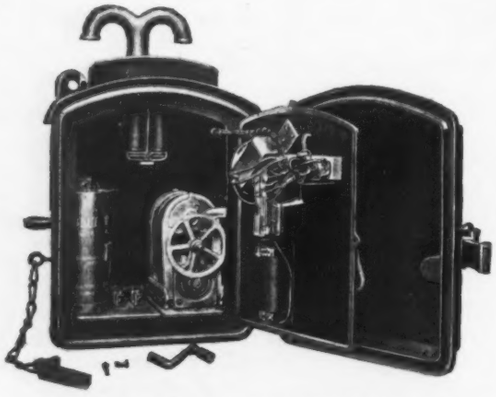


Fig. 2—Interior of Mine Telephone.

necessary to use the curved connector and the opening for it at the top of the set is closed by a suitable plug provided for the purpose.

The gongs are especially designed to give a loud, clear ring

Fig. 3—Mine Telephone Closed.

which can be heard a long distance in the mines; these gongs are protected by a hood, making it impossible for large particles of foreign matter to fall on them or interfere with their action.

The sets are equipped with a highly efficient five-magnet generator. The transmitters and receivers are of the standard "Bell" grade. All of the windings of the receivers, ringers, induction coils and generators are specially treated so as to protect them from the action of acid fumes, gases and moisture.

The company has also placed on the market a mine set protected by a case of specially treated wood having the same general features as the apparatus of the metal-covered set described above.

ELECTRIC HOISTS.

Fig. 1 herewith shows an electric hoist of special and heavy construction built for the McClintic-Marshall Construction Company, of Pittsburg, by the Mead-Morrison Manufacturing Company, of Cambridge, Mass. The hoists are claimed to possess certain features of advantage. One of these is the employment of patent twin screws by means of which the friction drums are operated, the construction and arrangement of the

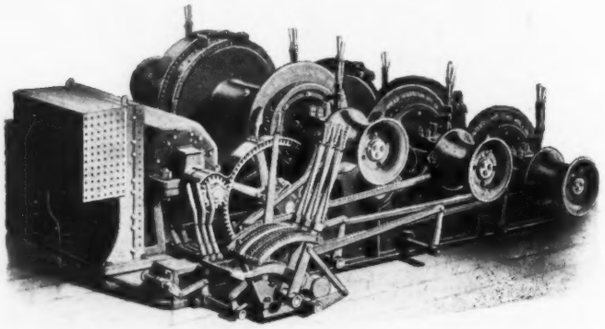


Fig. 1—Three-Drum Electric Hoist.

twin screws making it possible to extend the shaft beyond the thrust bearing to receive the spool, and this extension is effected without in any way reducing the efficiency or satisfactory operation of the friction drums. The twin screws are of small diameter, and the same sensitiveness and power of operation are obtained as with the usual arrangement of outside screws furnished with contractors' engines, and shown in section in Fig. 2.

In the arrangement of this machine it will be noted that the cut-steel gearing at the motor is kept within the frame. The other gears and the pinion of these machines are of steel, with shafts of large diameter and bronze-bushed drums. The thrust surfaces are of large area, and are provided with renewable split bronze thrust washers. Each spool is provided with a clutch lever, by means of which it can be unclutched from the shaft when desired. The hoist shown has three drums and six spools, the motor being of the heavy, mill-type construction, and the controller being manipulated by a hand lever carried in the quadrants with the friction-operating levers. The three-drum hoist is designed for handling girders up to 100 tons in weight,

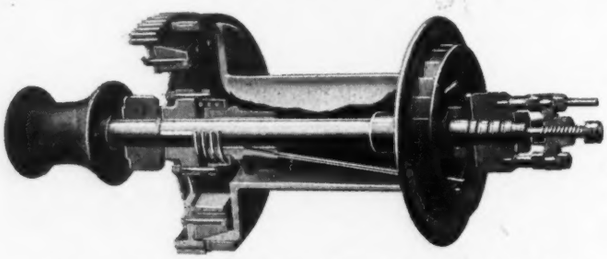


Fig. 2—Arrangement of Drum on Contractors' Engines.

and was furnished equipped with a 100-hp motor. The Mead-Morrison two-drum machines, also furnished to the construction company, are equipped with 75-hp motors and geared for handling loads up to 50 tons.

ROBBINS & MYERS FANS.

Among the numerous styles of fans offered by the Robbins & Myers Company for the season of 1910 special mention should be made of its 8-in. residence fan and its oscillating fan. The former is intended for ventilating and cooling rather limited areas, for which the 12-in. fan has often been found larger and more vigorous than necessary. The fan motor may be of either the direct-current or the alternating-current type; in either case the machine is provided with a commutator. Arrangement is made for two speeds, approximately 1000 r.p.m. and 1700 r.p.m. The slower speed is particularly adapted for sleeping and sick rooms, because at this speed the fan is practically silent. Even at the higher speed the fan is extremely quiet in running. In the alternating-current type, the motor may be designed for either 25 cycles, 60 cycles or 125 cycles. The 25-cycle fan can be used at any frequency from 25 cycles to 30 cycles, the 60-cycle fan can operate at from 40 cycles to 60 cycles, while the 125-cycle fan covers the range from 125 cycles to 133 cycles. By means of a wing-nut and trunnion-joint below the motor body, the fan may be arranged for use for either desk or bracket service.

Fig. 1—8-In. Fan in Desk Position.

In the oscillating fan use is made of a reversing vane which is moved from one operative position to the opposite operative position by the air currents from the fan, the vane being held and automatically released at the proper moment by a simple stop, which also serves to govern the sweep of oscillation. The oscillating movement will begin automatically whenever the fan is started, no matter in what position the fan may be stopped, and will reverse at any speed. The swinging portion of the fan is balanced within its yoke, thereby making the oscillating movement independent of the angle at which the fan may be inclined. The base is equipped with a worm-wheel operated with a thumb-piece, which permits the fan to be adjusted by hand to any angle desired, when it is being used in either the desk or bracket type, without in any way interfering with the oscillating movements. The oscillating motion is very smooth and entirely free from jar, while the mechanism is extremely simple and contains no parts having a tendency to wear.

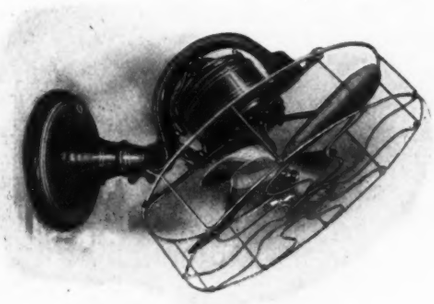


Fig. 2—Oscillating Fan.

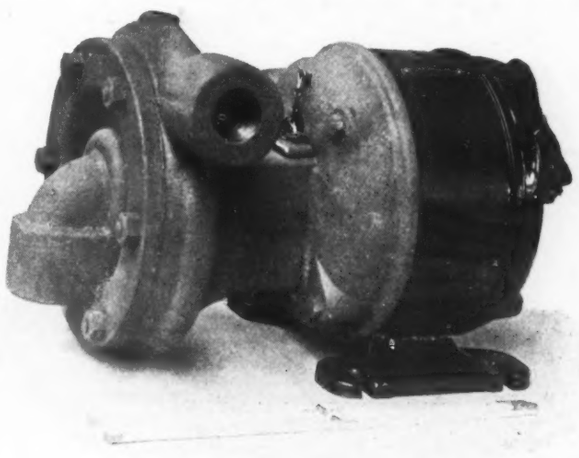
The oscillating fans are equipped with either commutator-type direct-current motors or induction-type alternating-current motors. In either case the motors are arranged for two speeds differing by about 15 per cent. At full speed of 1600 r.p.m. the 12-in. direct-current fan consumes 45 watts; the 16-in. direct-current fan uses 75 watts at its full speed of 1200 r.p.m. The alternating-current 12-in. fan at 1650 r.p.m. requires 67 watts, and the 16-in. alternating-current fan takes 100 watts at its full-load speed of 1550 r.p.m. By means of a device similar to that used with the 8-in. fan, the oscillating fan is convertible from a bracket to a desk type without the use of tools or any extra attachment.

ELECTRIC PUMPS FOR HOUSEHOLD WATER SUPPLY.

In that rapidly enlarging class of country houses and isolated homes where electrical power is available, the dependency for water supply need no longer rest on the unreliable and expensive operation of windmills and gasoline engines. Theoretically cheap as these agents are supposed to be, the one involves a large first cost with a service as little dependable as the wind which serves it, while the other requires the attention of a trained mechanic to supervise the complicated engine, to say nothing of the explosive nature of the fuel employed, and the dangers of ignorance in its operation.

But the electric motor-driven pump for house service, once installed, becomes a subject removed from the mind of the householder. It can be started and stopped by throwing a switch. An automatic cut-off can also be provided which will stop the pump when the water level in the roof tank has reached a predetermined height, starting the motor again before the storage supply has run low.

As shown in the accompanying illustration, the motor-driven volute pump for this class of service is compact and solidly constructed. The motor is of the Westinghouse alternating-current induction type, in which all special or delicate parts have been eliminated, resulting in a thoroughly dependable, sturdy, completely enclosed electrical machine, which transmits its output through a shaft directly to the impeller blades rotating in the cast-iron case seen at the left. This volute pump is designed to deliver 800 gal. to 1000 gal. per hour against heads up to 50 ft., when running at 2800 r.p.m. to 3300 r.p.m. per minute. The intake is shown at the left, entering at the center of the pump case, while the discharge orifice is the hole, threaded for a 1-in. pipe, seen opening toward the observer. There are, of course, no valves in this pump, and packings, pistons, etc., are also eliminated. The pump, which is arranged to be bolted onto the motor frame, making a compact unit, was designed and built by Henry R. Worthington, Harrison, N. J. Motors for this class of duty are built by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.



Electric Pump for Household Water Supply.

Industrial and Commercial News

The Week in Trade

CONSIDERED altogether, commercial business was probably slightly better last week than during the previous week. Reports, however, continue to show a certain degree of irregularity, which is particularly noticeable in the East and in the Southern Atlantic States; the West and Southwest are apparently in better shape. In that portion of the country more favorable weather conditions have existed, and these have tended to a more liberal movement of products to market and a better business at the retail stores. Orders being received by wholesalers and jobbers, while fair, are not all that have been anticipated, and the high prices of manufactured goods, and the uncertainty as to the permanence of such prices, are the principal barriers against the expansion of trade. The manufacturers find it difficult to reduce prices because raw materials are so high, and because present profits are upon a very narrow margin. The labor situation also is causing considerable anxiety, and many increases in wages will probably be demanded during the spring. The principal feature of importance last week was the sudden rush of orders for railroad equipment. The car-building companies were almost flooded with orders, and the American Locomotive Company has booked practically all that it can do for the next six months. The railroads seem to have suddenly awakened to the fact that they are short of equipment. During the last week, it is said, between 25,000 and 40,000 freight cars were ordered. Orders for quite a number of new passenger cars were also placed. In the building trades and in all outside industries there has been a considerable revival owing to the approach of pleasant weather, and there is a demand for building materials that is heavier than has existed since last summer. Collections continue to be slow and unsatisfactory. Business failures for the week which ended March 10, as reported by *Bradstreet's*, were 250, as compared with 184 the previous week, 254 in the same week of 1909, 278 in 1908, 186 in 1907, and 187 in 1906.

The Copper Market.

CONDITIONS in the copper market during the past week were not as satisfactory as had been hoped. The feature of the week, of course, was the February report of the Copper Producers' Association, which showed that an increase in surplus stocks of 8,724,000 lb. had been made during February. The figures for February were: Production, 112,712,493 lb.; domestic deliveries, 66,618,322 lb.; exports, 37,369,518 lb.; thus making total deliveries of 103,987,840 lb., and leaving the addition above noted to the surplus stocks. The total surplus in this country on Feb. 1 was 98,463,339 lb., and on March 1 it was 107,187,902 lb. As a result of this poor statistical showing, the market has been weaker during the past week, and prices have shown an inclination to decline. This has been true both in Europe and in this country. Another discouraging feature of the market is the evidence that production is again on the increase. Some traders are of the opinion that the production for March will exceed even the record-breaking output of last November. On the basis of February, the production for March would be about 123,000,000 lb. At present there seems to be litle interest taken by speculators abroad, and it does not seem likely that the exports for March will be sufficient to offset the light domestic takings. For the month, including March 14, the exports have been 7,683 tons. The daily call on the metal exchange, March 14, quoted standard copper according to the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.87½	13.12½	.....
February	12.87½	13.12½	13.00
March	12.87½	13.12½	13.00

Market dull.

The London market, March 14, was as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	59	2	6	59	5	0
Standard copper, futures	60	1	3	60	3	9

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.95c		
London, spot	£62	0	0	£58	17	6
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	63	0	0

Commercial and Industrial Notes.

The Platinum Situation.—Speaking of the platinum situation, which was referred to in our last issue in connection with the reported action by the Russian government, Cyrus Osborne Baker, one of the leading importers of crude platinum and one of the most important platinum refiners in this country, said: "While I have no definite information from Russia on this subject, I do not believe that the Russian government has taken any action such as has been reported. These things have been talked of many times before, but the government has taken no action further than to permit platinum to be used as security for loans from the Imperial Bank. I do think, however, that the same result, that is, the advancing of the price of platinum, will be achieved by other methods. The platinum miners in Russia have formed a rather strong organization, and we expect that this organization will be able to dictate the price of crude platinum. Fully 90 per cent of the platinum of the world is produced by these miners in Russia. They, therefore, have the market at their mercy. As far as I know, there is no truth in the statement that the Russians are going into the refining business. There are no platinum refiners in Russia that I know of, and I think I would know if any were operating there. Platinum is mainly refined in Germany, France, England and America, and I do not believe the Russians will undertake it. We have fought in this country to keep the price of platinum down, and any charge that Americans are interested in a trust is ridiculous. There is more platinum being used at the present time than ever before, and I believe that an increase in price will serve to stimulate production. The Russians, however, practically control the situation."

Westinghouse Storage Battery Company Sold.—The Westinghouse Storage Battery Company, which was incorporated under the laws of New York, July 12, 1909, with a capital of $1,750,000, of which $250,000 was in 6 per cent preferred stock, has sold out its entire rights and patents to the Electric Storage Battery Company, of Philadelphia. The Westinghouse company was a combination of the storage battery department of the Westinghouse Machine Company and of the General Storage Battery Company, of Boonton, N. J. The plant of the concern was at Boonton, and the company manufactured both the Westinghouse and Bijur types of batteries. The Boonton plant was destroyed by fire Feb. 6, and on March 10 a fire at the East Pittsburgh shops of the Westinghouse Machine Company destroyed considerable manufactured stock. The Westinghouse Battery Company will be liquidated, and will be out of business. The officers of the company were: H. H. Westinghouse, president; H. T. Herr, vice president; S. B. Dusinberre, vice president and general manager.

Studebaker Electrics Not Sold.—Announcement was made last week that J. P. Morgan & Company had purchased the holdings of the Detroit and Port Huron stockholders in the Everitt-Metzger-Flanders Company, manufacturing the E. M. F. and Flanders gasoline automobiles. These concerns have heretofore been managed and operated by the Studebaker company. It is said that the deal involved about $5,000,000, but the Morgan firm announces that it simply acted as agent in the matter and is not going into the automobile manufacturing business. At the offices of the Studebaker company it was distinctly announced that this deal had no connection with the Studebaker electric vehicles. These vehicles will continue to be manufactured by the Studebaker company at South Bend, Ind., and Elyria, Ohio. It was stated by a representative of the company that the demand for electric vehicles, especially commercial wagons, was greater than it had ever been before.

Westinghouse Electric & Manufacturing Company.—The Interborough Rapid Transit Company contracted last week with the Westinghouse Electric & Manufacturing Company for four 3000-kw rotary converters and twelve 1100-kva air-blast transformers. These machines are duplicates of sets purchased last June. They are to be used to replace 1500-kw converters, which will be installed in other substations.

New York Pneumatic Service Company.—The United States Treasury Department last week awarded to the New York Pneumatic Service Company the contract for the installation of a double pneumatic-tube service between the Custom House at Bowling Green and the appraiser's warehouse at Washington and Christopher streets, New York City. The tubes will be 8 in. in diameter, the same as those used by the Post Office Department, and the contract price was $173,250. The line will run under Washington Street from the warehouse to Battery Place, and under that street to the Custom House at State Street. At one of the terminals, presumably at the Custom House, the compressors and blowers will be electrically operated, and at the other terminal they will be operated by steam. The contract required that work shall be commenced before March 28, and the service shall be completed for operation by Dec. 31. The officials of the company state that business has been very active within the past year. A new tube line is being constructed for the Post Office Department from the Grand Central substation, at Forty-fifth Street, under Lexington Avenue to Station "L," at 125th Street. From there a cross-town tube will be constructed to Station "J," at 124th Street and Eighth Avenue. A cross-town line has also been constructed within the past year from the Grand Central Station to the Times Square Station in the McGraw Building, 239 West Thirty-ninth Street. A new line has also been built between Station "O," at 122 Fifth Avenue, to Station "C," at Thirteenth and West streets. The Government has not yet contracted for the foreign mail station which was to have been located at Morton and West streets. It is probable that, since so many of the important transatlantic lines have moved further north to the Chelsea piers, this station will be given a new location nearer these lines. The majority of the compressors for these new tubes will be operated by electric motors.

Colorado River Power Company.—The Colorado River Power Company of Marble Falls, Tex., having a capital stock of $1,000,000, has filed its charter in the secretary of state's office. The company will soon have completed a dam across the Colorado River at Marble Falls costing several hundred thousand dollars, and the erection of a hydroelectric plant will soon be started. This proposed plant will have an initial rating of about 5000 hp, and provision is made whereby additional water storage can be easily obtained that will afford double the amount of the power of the original plant. The company is preparing to build transmission lines to San Antonio, about 90 miles; to Austin, about 35 miles; to Waco, about 100 miles, and to a number of smaller towns within a radius of 150 miles. It has also contracted to furnish electric energy for a cotton mill and other industries at Marble Falls. The dam here is 750 ft. long, 50 ft. high, and has an 80-ft. base with a 16-ft. crown. It is a sluice dam, with chambers in the interior, and is made of concrete reinforced with steel. The dam was designed and constructed by J. C. Dumont, who is also negotiating with the municipal authorities of Austin for the building of a similar structure at that place.

Fort Wayne Electric Works.—The Fort Wayne (Ind.) Electric Works, which is incorporated under the laws of New York, has certified to the Secretary of State at Albany that it has increased its capital stock from $1,500,000 to $2,500,000. The company is practically owned by the General Electric Company, and among those who signed the certificate are: M. F. Westover, John Riley and J. R. Lovejoy, officials of the General Electric Company. At the offices of the Fort Wayne Electric Works, in New York, it was stated that the increase in capitalization has been made necessary by the growth of business being done by the plant, and that extensive improvements are being made to the factory buildings. Plans for these improvements were drawn in 1907, but work was not begun until recently, owing to the period of depression. A new four-story machine shop, 229 ft. by 140 ft., is being constructed, and will be known as Building No. 17. In addition to this a new five-story office building, 60 ft. front, is also being built. The company has been doing a very heavy business in small motors and similar apparatus, and also in electric meters. It received last year one order from the Commonwealth Edison Company for 20,000 meters.

Westinghouse Gas-Producer Installations.—The Page-Storms Drop Forge Company, Chicopee, Mass., has installed a Westinghouse Type J-60 gas-producer plant for generating fuel gas from buckwheat anthracite to supply a 300-hp Welbe gas engine, which was formerly served by two producers of the same make. The Westinghouse gas producer is of the suction type and represents the standard design of the Westinghouse Machine Company, East Pittsburgh. The plant of the Page-Storms Drop Forge Company furnishes 60-cycle alternating current for local lighting and light power operations. Lawrence Foy has been in charge of the erection of the new unit for the Page-Storms company. The new factory of Stanley G. Flagg & Company, Stowe, Pa., will be supplied with power from a 300-hp producer plant driving a 175-kw direct-current generator. The engine is of the horizontal, double-acting Westinghouse producer-gas type, and develops 300 hp by brake test. The engine is direct-connected to a 175-kw direct-current generator, furnishing 110-volt current for lighting and power in the new factory.

Long Island Railroad Tunnels.—It was definitely announced last week that the Long Island Railroad would run its first passenger trains through the tunnels from the Pennsylvania terminal in New York City under the East River as far as Jamaica, L. I., on May 15. While not yet completed, the New York terminal is in shape to handle these Long Island trains. It has not been definitely announced whether transfer arrangements will be made which will permit passengers from other branches of the Long Island Railroad to use the tunnel trains. Plans looking to this transfer are being considered. It is said that Pennsylvania Railroad trains under the Hudson River will probably be operated in June or July, but no definite date has been fixed.

Keller Manufacturing Company.—The Keller Manufacturing Company, of Philadelphia, maker of vacuum cleaners, has purchased the business of the W. P. Pressinger Company, of New York, its general Eastern distributor and distributor for Michigan, and this territory will hereafter be handled direct. J. J. Swan, secretary of the W. P. Pressinger Company, will be associated with the Keller Manufacturing Company. Charles Strader has been placed in charge of Western agencies, with offices at Chicago and Lincoln, Neb. The Keller company has elected the following officers: Julius Keller, president; W. P. Pressinger, William H. Keller and S. W. Prince, vice-presidents; Francis J. Rue, treasurer, and C. S. Bell, secretary.

Allis-Chalmers Company Sales.—The Ford Plate Glass Company, of Toledo, has placed an order with the Alllis-Chalmers Company for a 2500-kva. 580-volt, 1200-r.p.m., 40-cycle, three-phase alternator direct-connected to an Allis-Chalmers steam turbine; also for a 120-volt, direct-current generator, direct-connected to the end of the turbine shaft. The same company has sold to the St. Louis Plate Glass Company one 750-kw, 60-cycle steam turbo-generator; one 500-kw synchronous motor-generator set; one 22½-kw induction motor-generator exciter set; one 150-hp induction motor and a three-panel switchboard.

Canadian Hydroelectric Power.—Two additional municipal contracts for hydroelectric power have been received by the Canadian Hydroelectric Commission. The town of Norwich proposes to take 150 hp at $30 per hp.-year, and the town of Tilsonburg has asked for 500 hp at $30.50 per hp-year, the difference being due to the difference in length of transmission to the two municipalities. The two corporations will be served by a feeder line from Woodstock. The line will be a low-tension distribution, which will enable service to be rendered to the farmers along the route.

Canadian Westinghouse Company.—The Canadian Westinghouse Company has obtained the contract for supplying the electrical equipment for the St. Thomas, Ont., municipal plant for the distribution of Niagara hydroelectric energy at $18,170. The same company was awarded the contract for the municipal generating station at Winnipeg at $113,000. Chapman & Walker sceured the contract for the heating, generating and lighting system inside the station at $8,225, and the Canadian Fairbanks Company was given the contract for oil for the transformer station at $6,482.

Erindale (Ont.) Power Company Damaged.—As a result of the mild weather on March 7, the Credit River rose 5 ft. and broke through the concrete dam which the Erindale Power Company is building on the river at Erindale. The dam is about 700 ft. wide at this point, and the rushing water and ice tore a gap about 100 ft. at the center of the dam. The company had expected to be in a position to supply electric energy by April 1, but the accident will delay it for a month longer.

Western Union Buys American District.—The Western Union Telegraph Company announces that it has acquired a very large minority interest in the stock of the American District Telegraph Company of New Jersey. The company has been controlled, practically, by the Western Union since its organization. The American District Company has outstanding $9,965,351 capital stock. It was organized in 1901, and acquired control of the district messenger companies operating in all the cities and towns of importance throughout the United States except in the Borough of Manhattan. Upon its organization the company made a 25-year contract with the Western Union Company for the collection and delivery of messages. The company paid 5 per cent dividends up to 1904, after which the rate was reduced to 4 per cent, which has been paid since. It is said that the earnings last year were equivalent to nearly 10 per cent on the outstanding stock.

New Haven Railroad Electrification.—Timothy E. Byrnes, vice president of the New York, New Haven & Hartford Railroad Company, told the Massachusetts Legislature last week that if given the proper permission a tunnel would be constructed between the north and south stations in Boston, and vast improvements made to the Boston terminals. This purpose was referred to in our issue of Feb. 17. He said that electrification would be carried along with the construction work, that in three years the tunnel could be completed, and that by that time a part of the suburban service out of Boston would be electrified. He said that the road was ready to spend $16,000,000 on the project.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Rumford, Me.; Duluth, Minn.; Fort Sill, Okla.; Perrysburg, Ohio; Cairo, Ill.; Nashville, Tenn.; St. Louis, Mo.; Winnipeg, Man., Can.; Black River Falls, Wis.; Chicago, Ill.; Los Angeles, Cal.; Hartford City, Ind.; Morgantown, W. Va.; Stafford, Kan.; Condon, Ore.; Hastings, Mich.; Anamosa, Ia.; Delavan, Wis.; Manchester, Conn.; Long Beach, Cal.; Jamestown, N. Y.; Edison, Ga.; Smyrna, Ga.; Denmark, S. C., and Pearsall, Tex.

Canadian General Electric Company Receives Contract for 200,000-hp in Generators.—The Canadian General Electric Company has recently closed the following orders for electric generators: Electrical Development Company of Ontario, three 1500-hp generators for use at Niagara Falls; Ontario Power Company, three 12,500-hp generators for use at Niagara Falls; Western Canada Power Company, two 10,000-hp generators for use at the Stave Lake, Vancouver, B. C., plant. In addition to the above large orders, small ones for generators aggregating 100,000-hp have been recently booked.

Financiers to Make Automobiles.—It is said that a number of the leading financiers of Wall Street have formed the Orson Automobile Company, for the purpose of manufacturing automobiles for their own use upon plans prepared to suit them. A factory will be established, probably at Springfield, Mass., and placed under the control of skilled engineers, who will assemble automobiles, the parts of which are manufactured by various companies throughout the country. Many of the most prominent financiers in Wall Street are interested in the project.

Financial.

The Week in Wall Street.

THE tone of the market in Wall Street last week continued cheerful, and for the most part prices advanced. Trading was not extremely active, but there was some evidence of outside buying for invesment, both of bonds and of stocks. As a matter of fact, it appears that the Wall Street community has gotten over its fright, and traders have about made up their minds that no further trouble is going to happen, either in the shape of adverse court decisions or of drastic legislation. The symptoms of demoralization which appeared in the street about a month ago have entirely disappeared, and at the present time it does not seem to be a very profitable business for bears to attempt to depress prices. There can be heard now more talk of higher prices than at any time within the past two months, and whether this is due to a genuine sentiment of optimism, or simply to a program of boosting, makes little difference in the result. It is having its effect, and the condition of the Wall Street market is undeniably strong. During the past week quite a number of important bond issues were advertised, and although bond houses declare that the market is dull, the firms which have had the placing of these issues assert that subscriptions are liberal. There seems to be an especial activity in public utility bonds, and this class of investment is probably more popular at this time than ever before. The money market continues to be entirely easy, and the banks are liberal to borrowers. Quotations March 14 were: Call, 2¾@3 per cent; 90 days, 3¼@3⅜ per cent. The quotations in the table are those of the close March 14.

NEW YORK.

	Mar. 7.	Mar. 14.	Shares sold.		Mar. 7.	Mar. 14.	Shares sold.
All.-Ch.	12	12⅛	500	Int.-Met., pfd.	56⅜	56¾	40,300
All.-Ch., pfd.	43*	45*	900	Mackay Cos..	91	90¼*	950
Amal. Cop...	83¼	79¼	227,200	Mackay C., p.	76½*	77*	600
Am. D. T....	20½*	20½*	——	Man. Elev....	138¾	139*	702
Am. Loc.....	55⅜	52½	8,100	Met. St. Ry..	15*	15*	100
Am. Loc., pfd.	112½	112½	500	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75	75*	100	Steel, com....	88½	88⅝	1,176,110
Am. T. & T..	142	141⅝	12,700	Steel, pfd....	122	122	11,320
B. R. T.....	76½	76⅝	60,980	W. U. T.....	78	76¼	6,556
Gen. Elec...	155½	155	4,500	West'h., com.	73½	73*	14,500
Int.-Met.,com.	22½	22¼	44,500	West'h., pfd..	125	125	200

PHILADELPHIA.

	Mar. 7.	Mar. 14.		Mar. 7.	Mar. 14.
Am. Rys.....	45¾*	45½	Phila. Elec.....	15¼	15⅛
Elec. Co. of A.....	12*	12⅛*	Phila. R. T.....	23	21
Elec. St. B'ty.....	61	63	Phila. Trac.....	89	86
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	49⅜	48½

CHICAGO.

	Mar. 7.	Mar. 14.		Mar. 7.	Mar. 14.
Chi. City Ry.....	185	185*	Chi. Tel. Co.....	132	132
Chi. Rs., Ser. 1.....	106*	106*	Met. El., com.....	17*	17*
Chi. Rs., Ser. 2.....	32	32⅜*	Met. El., pfd.....	55*	53¾
Com. Edison.....	115	116¼	Nat'l Carbon.....	108½	112½
Chi. Subways.....	3½*	3*	Nat'l Car., pfd.....	119	120*

BOSTON.

	Mar. 7.	Mar. 14.		Mar. 7.	Mar. 14.
Am. T. & T.....	142	141⅝	Mex. Tel.....	4	4¼
Cum. Tel.....	150¼*	152*	Mex. Tel., pfd.....	6*	6¼
Edison E. Ill.....	247½	251	N. E. Tel.....	137	138
Gen. Elec.....	155½	155½	W. T. & T.....	16	16½
Mass. E. Ry.....	18¼*	18*	W. T. & T., pfd....	88	89
Mass. E. R., pfd....	83½	84½*			

* Last price quoted.
Shares sold are for week of March 7 to March 12.

Financial Notes.

Union Switch & Signal Company.—At the annual meeting of the Union Switch & Signal Company in Pittsburgh last week, George Westinghouse, president, told the stockholders that, while the company's statement of business for 1909 did not show a very large profit, since the beginning of the year its business had considerably improved. He said that the earnings for January alone exceeded the amount of the first quarter's dividend. Referring to the wisdom of increasing the plant, he said that the company was now in a position to care for 50 per cent more business than it had ever done during the most prosperous period of its history. H. G. Prout, vice-president and general manager, said that for the first six months of 1909 the company ran about even, earnings and expenses being practically the same. The profits shown in the yearly report were from the business of the last six months. The business for February, he said, was even larger than that for January, and at the present time there were over $2,000,000 of unfinished orders in the shops. John P. Miller, vice-president of the Westinghouse Air Brake Company, was elected a director to succeed the late Robert Pitcairn.

Utility Bond Offerings.—Among the important public utility bond offerings made during the past week were: $2,750,000 Galveston-Houston Electric Railway first mortgage 5 per cent bonds, offered by Lee, Higginson & Company at 95 and interest; $1,244,000 Rochester Railway & Light Company 5 per cent bonds, offered by N. W. Harris & Company at 100 and interest; $30,000,000 Southern Power Company 5 per cent bonds, offered by N. W. Harris & Company and the National City Bank; $10,000,000 New York Telephone Company 4½ per cent bonds offered by Kidder, Peabody & Company at 97½, and the unsold balance of the $80,000,000 general mortgage 5 per cent bonds of the Public Service Corporation of New Jersey, offered by J. P. Morgan & Company at 97 and interest. It is understood that $7,000,000 of this latter issue has already been sold.

Watertown (N. Y.) Light & Power Company.—The gross earnings of the Watertown Light & Power Company in 1909 were $376,014, as compared with $342,676 for the previous year. The net earnings for the year were $122,729, as compared with $137,304. This decrease in net earnings was due to an increased charge of $21,099 for depreciation during the year 1909.

Cutting Metallic Filament Lamp Prices in Europe.—As previously noted in these columns, the Allgemeine Elektrizitats Gessellschaft recently made a great reduction in its prices for tungstem lamps. Following this, two conferences of German filament lamp manufacturers have been held in Berlin, and at the second one, which was attended by representatives of all the German incandescent lamp manufacturers, with the exception of A. E. G., a resolution was adopted to the effect that none of the firms represented should lower their prices until March 10, after which date all manufacturing firms could fix any prices they pleased. It is said that after that date the prices of the A. E. G. will be met. An effort was made to form a national tungsten lamp price association, but without success. It is stated that the sudden lowering of prices by the A. E. G. was aimed at the German Auer Company, which recently added to its gas mantle business that of manufacturing tungsten lamps, of which it is turning out 40,000 to 50,000 per day. In England the price of tungsten lamps has also been cut, but the owners there of the Osram patents claim that they will be able to control, through the patents, the situation, not only with respect to British lamp manufacturers, but also in preventing the importation of low-priced German tungsten lamps.

Three-Cent Bridge Line.—The Manhattan Bridge Three-Cent Line has submitted to the Public Service Commission an estimate of the cost of the line and of its probable earnings. John C. Brackenridge, vice-president of the company and formerly chief engineer of the Brooklyn Rapid Transit Company, prepared the figures. He estimates that the line will cost about $850,000, including the promotion charges. This includes $240,000 for cars, $125,000 for a power house and $50,000 for a car barn. He estimated that the line would have 30,000 passengers per day, which would, at 3 cents, bring in a gross revenue of $900. The actual cost of operation he estimated to be about 2¼ cents per passenger, and he believed that the net yearly income available for payment of fixed charges would not fall below $92,125.

Minneapolis General Electric Company.—It is said that practically all of the $1,000,000 of new common stock which was offered to its stockholders by the Minneapolis General Electric Company at par was taken when the subscription books closed on March 2. The proceeds of this new issue are to be utilized in installing a new unit at the water-power plant at Taylor's Falls and in extensions to the transmission lines running into Minneapolis, about 40 miles in length. It is believed that when these improvements are completed the company will be in a position to materially increase its revenue. Since the management of the property was assumed by Stone & Webster, in 1899, it has developed rapidly in earning capacity. The gross returns in 1899 were $284,054 and in 1909 were $1,108,750.

Westinghouse-General Electric Rumor.—With regard to widespread publications that an amalgamation had been made between the General Electric Company and the Westinghouse Electric & Manufacturing Company, involving a new corporation capitalized at $150,000,000, A. W. Burchard, assistant to the president of the General Electric Company, had this to say: "Such stories are absurd and I can conceive of no reason why they are circulated unless it is for stock jobbing purposes. If such a combination had ever been contemplated—which it has not—this would not be a happy time for bringing it about. There are no trade arrangements between the two companies, there is no price combination and we are altogether competitive. There is nothing in this story of combination.

More Time for Washington, Baltimore & Annapolis.—Judge Morris, of the United States Circuit Court of Baltimore, has signed an order extending the time of the receivers of the Washington, Baltimore & Annapolis Electric Railway Company to pay the coupons due March 1 on the terminal 5 per cent bonds. The receivers say that they will be able to pay this interest in 90 days. The order will prevent foreclosure proceedings. This property is part of the electric line and covers all of its terminals in Baltimore.

Electric Securities at Auction.—At the auction of securities in New York last week the following electrical securities were sold: 76 shares Consolidated Fire Alarm Company preferred, par $100, at 20½; 63 shares Consolidated Fire Alarm Company common, par $100, $66 for the lot; 100 shares Fire Alarm Telephone Signal Company, par $50, $32 for the lot; $10,000 Central Colorado Power Company first mortgage 5 per cent bonds, 50 shares same company preferred, 50 shares common, at $6,025 for the lot.

Columbia Gas & Electric Company.—The United Fuel Gas Company, of Huntington, W. Va., has taken over the West Virginia holdings of the Columbia Gas & Electric Company, of Cincinnati. The deal includes over 500 miles of pipe line and 100,000 acres of gas territory. The sale carries the stipulation that the purchaser shall furnish gas in wholesale quantities to the Cincinnati trade. The amount involved is about $4,500,000.

DIVIDENDS.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable April 15.

General Motors Company, preferred, 3½ per cent, payable April 1.

Louisville Traction Company, preferred, semi-annual, 2½ per cent; common, 1 per cent; payable April 1.

Manila Electric Railroad & Light Company, quarterly, 1 per cent, payable April 1.

Otis Elevator Company, preferred, quarterly, 1½ per cent; common, semi-annual, 1½ per cent; both payable April 15.

Philadelphia Traction Company, semi-annual, 4 per cent, payable April 1.

Seattle Electric Company, semi-annual, preferred, 3 per cent, payable April 1.

Toronto Railway Company, quarterly, 1¾ per cent, payable April 1.

Twin City Rapid Transit Company, preferred, 1¼ per cent, payable April 1.

Union Railway, Gas & Electric Company, preferred, quarterly, 1½ per cent, payable April 1.

Union Switch & Signal Company, quarterly, preferred and common, 3 per cent, payable April 9.

United Gas Improvement Company, Philadelphia, quarterly, 2 per cent, payable April 15.

Utah Copper Company, quarterly, 75 cents per share, payable March 31.

West End Street Railway Company, Boston, semi-annual, 3½ per cent, payable April 1.

Western Union Telegraph Company, quarterly, ¾ per cent, payable April 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Eastern Pennsylvania Railways Company, Pottsville, Pa.:					
January, 1910	$54,048	$30,772	$20,276	.....	.....
January, 1909	43,246	27,606	15,640	.....	.....
Interborough Rapid Transit Company:					
Eight months ended February 28, 1910	18,851,863	7,228,620	11,623,243	.....	.....
Eight months ended February 28, 1909	17,050,091	7,168,920	9,881,170	.....	.....
Kansas City Railway & Light Company:					
January, 1910	611,919	324,451	287,468	$155,405	$132,063
January, 1909	550,947	329,156	221,791	155,562	66,228
Mexican Light & Power Company (Mexican Currency):					
January, 1910	563,847	112,885	450,932	.....	.....
January, 1909	556,275	146,875	409,400	.....	.....
Mexico Tramways Company (Mexican Currency):					
January, 1910	460,881	230,889	229,993	.....	.....
January, 1909	444,078	226,527	217,551	.....	.....
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
February, 1910	74,271	43,419	35,852	22,067	13,785
February, 1909	73,251	38,665	34,586	20,938	13,648
Toledo Railway & Light Company:					
January, 1910	258,219	151,762	106,457	75,213	31,494
January, 1909	225,216	130,059	95,157	71,013	24,244
Toronto Railway Company:					
Year 1909	3,926,828	1,995,914	1,930,914	838,532	1,092,382
Year 1908	3,610,274	1,889,047	1,721,226	774,028	942,198
Western Telephone & Telegraph Company:					
Year ended January 31, 1910	.....	.....	2,169,612	1,308,171	861,471
Year ended January 31, 1908	.....	.....	2,225,166	1,395,756	829,407
Western Union Telegraph Company:					
Quarter ended March 31, 1910 (Estimated)	.....	.....	1,750,000	433,063	1,316,937
Quarter ended March 31, 1909	.....	.....	1,684,893	433,062	1,251,831

General News

Construction News.

BIRMINGHAM, ALA.—It is reported that the Birmingham Railway, Light & Power Company is contemplating building an extension of its street car lines to Elmwood Cemetery.

SYLACAUGA, ALA.—The City of Sylacauga has acquired the water rights at the McEwen's mill site on Hatchett Creek, which it proposes to develop to generate electricity, to be utilized for lighting the town and operating local industries.

LITTLE ROCK, ARK.—The City Council has adopted the resolution appropriating $5,000 for the construction of a new power house for the municipal electric light plant and $50,000 for equipment of the same.

RUSSELLVILLE, ARK.—The Southern Anthracite Coal Company is contemplating the installation of two generators, 75 and 35 hp respectively, to supply electricity to operate fans in mines, hoist coal and for lighting mines and 100 miners' cottages.

AUBURN, CAL.—Surveys are being made under the direction of William Muir, with a view of bringing water from a point below Forest Hill to Green Point, at the junction of the North and Middle Forks of the American River, about three miles from Auburn. It is understood that Mr. Muir will erect a power plant at Green Point, with an output of from 25,000 to 30,000 hp. The present plans call for the construction of two ditches, extending from near Forest Hill to Green Point, a distance of 20 miles, which will meet at Green Point, where a fall of about 600 ft. will be secured.

BERKELEY, CAL.—The City Council is considering the question of establishing a municipal electric light plant in Berkeley.

FRESNO, CAL.—John S. Eastwood has assigned to the Mammoth Power Company water rights appropriation of 50,000 in. of the San Joaquin River, with reservoir site location in Fresno County; also like appropriation with Mammoth Paul site in Madeira County; also to Pacific Light & Power Corporation 10,000 in. appropriation out of Big Creek, and 20,000 in. of Pitman Creek in Fresno and 10,000 in. of the San Joaquin River, made in 1903. The Mammoth Power Company has assigned to the Pacific Light & Power Corporation above appropriations.

HALFMOON BAY, CAL.—Benjamin Cunna is reported to have secured a franchise for lighting Halfmoon Bay.

LONG BEACH, CAL.—It is reported that negotiations have been closed whereby a site has been secured in Long Beach for the proposed plant of the Edison Electric Company of Los Angeles. The plant will be located at the mouth of the San Gabriel River, just south of the ocean entrance to the Long Beach harbor. It will be a steam-driven plant and the initial equipment will have an output of 30,000 hp with provisions to increase it eventually to 100,000 hp. The plant will be the center of a distributing system which will practically include all the beach towns—Long Beach, Redondo, Naples, Venice, Ocean Park, Santa Monica, San Pedro and Wilmington. Work will commence at once on construction of the plant and will be completed within a year. The initial installation will cost about $2,000,000. R. H. Ballard is secretary of the company.

LOS ANGELES, CAL.—Messrs. Edwards & Wiley have been granted a franchise by the City Council to construct a street railway on Melrose Avenue, Los Angeles, for which they paid the sum of $100.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has secured the right of way for an extension of its La Habra line from the present terminus at Pillsbury via Olinda to Riverside, a distance of six miles.

LOS ANGELES, CAL.—The Babcock & Wilcox Company, of New York, N. Y., has secured the contract for installing six Stirling water-tube boilers in the plant of the Los Angeles Gas & Electric Company, at Palmetto and Alameda Streets.

LOS ANGELES, CAL.—The City Council has adopted the ordinance calling for an election April 19 to vote on the proposition to issue $6,500,000, of which $3,000,000 will be used for the construction of an electric power plant and distributing system to supply electricity for lamps, heat and motors in Los Angeles.

LOS ANGELES, CAL.—The Pacific Light & Power Coompany of Los Angeles, recently incorporated, has offered for sale to its present stockholders its first preferred capital stock to the amount of $3,000,000, the proceeds to be used for the construction of a new 10,000-kw plant in Redondo, the erection of distributing lines and other extensions; also to take up the floating indebtedness of the Pacific Light & Power Company.

OROVILLE, CAL.—The report that the Oroville Water, Light & Power Company contemplates beginning work on the construction of its dam in Hamburg Valley this summer is denied by R. Leo van der Naillen, manager of the company. He states that the company proposes ultimately to establish a power plant there, but nothing is contemplated for the immediate future.

OXNARD, CAL.—Plans are being made by the Pacific Telephone & Telegraph Company for the installation of 18 miles of new cables and other improvements in Oxnard and vicinity, which will involve an expenditure of about $18,000.

RED BLUFFS, CAL.—Notice of application of 300,000 in. of water of the Sacramento River, to be taken out at the mouth of Red Bank Creek, located about three miles south of Red Bluff, has been filed by Dr. J. M. West, director of the Tehama County Power & Transportation Company. The water is to be used in Tehama, Glenn, Colusa and Yolo counties, for irrigation, generating electricity, domestic and other purposes. The company was organized some time ago, and has filings on waters along Mill Creek for power purposes.

SALINAS, CAL.—Work has been commenced by the Monterey County Gas & Electric Company on construction of its transmission lines to Spreckels, for the purpose of supplying electricity in that town for lamps and motors from its plant at Monterey. The line will extend from Monterey to Castroville, thence to Salinas, and from Salinas to Spreckels. The plant at Salinas will not be abandoned, but will be held in reserve for emergencies.

SANTA ANA, CAL.—The Southern California Edison Company has applied to the Board of Supervisors for a franchise to erect transmission lines on the roads and highways in Orange County.

SUTTER CREEK, CAL.—The Amador Electric Railway Company has been reorganized under the name of the Amador Electric Light & Power Company. The company has furnished electricity for a number of years in Sutter Creek, Amador City and Jackson, originally having a small plant in Sutter Creek. Later an arrangement was made with the California Gas & Electric Corporation to secure electricity from its plant at Electra to operate its system. E. C. Voorhees is president of the company, and C. A. Downs, secretary.

FOWLER, COL.—The City Council has approved the ordinance granting a 20-year franchise to G. E. Miles, of Denver, Col., and G. E. Williams, of Sheridan, Wyo., to construct and operate an electric light plant in Fowler.

LAFAYETTE, COL.—Preparations are being made by the Northern Colorado Power Company for extending its 40,000-volt transmission line from Lafayette to La Salle in the near future. The company will supply electricity in Erie and one or two other mining towns on the way. From La Salle the line will extend to Greeley, so as to make a complete loop, by which any town of the Northern Colorado district may be fed in either direction. The towns of La Salle and Kersey are being generally wired for electric lamps.

HEBRON, CONN.—The question of lighting the streets of the town by electricity is under consideration, the service to be furnished by the Colchester Electric Light & Power Company.

JEWETT CITY, CONN.—A town meeting will soon be held to consider the question of improving the lighting system of the borough. Owing to the condition of the engines in the municipal electric light plant, steps will have to be taken either to improve the plant or to secure electricity from outside parties. Several months ago the Electric Light Commissioners contracted with the Nashawaug Light & Power Company, of Killingly, Conn., to furnish this borough with 90,000 kw at $4,500 per year, but the contract was broken as the company found it could not furnish the service at that price. Since then Harold D. Lawton has become interested in the company and has submitted a proposition to the commissioners offering to supply the same amount of power for $5,000, which will be considered as well as installing new engines in the power plant.

MANCHESTER, CONN.—Plans are being made by the Glastonbury Light & Power Company to improve the lighting service in Manchester during the coming summer, which will include the erection of a new power house in Glastonbury, located near Folly Brook, and a substation in Manchester and the erection of new transmission lines. It is expected to have the work completed about Aug. 1, 1910.

NORWICH, CONN.—It is reported that the Norwich, Colchester & Hartford Traction Company has decided to commence work on the construction of its proposed electric railway, 40 miles in length which will connect Hartford and Norwich.

WILMINGTON, DEL.—The Trustees of the State Hospital for the Insane at Farnhurst have awarded a five-year contract for supplying the institution with electricity to the Wilmington City Electric Company, for $2,500 per year, which is an increase of $100 per year on the last contract.

WASHINGTON, D. C.—Application has been made by the East Washington Suburban Railway Company for a charter in Washington, D. C., for the purpose of constructing an electric railway in the District of Columbia and to connect with the Anacostia & Potomac River Railroad. Samuel E. Cox, William A. Harrison, A. W. Harrison and others are interested in the project.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until

March 29 for furnishing at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 2283.—Two motor-driven boring and turning mills, a roll metal-sawing machine, eight sensitive bench drills. Mare Island, Cal., or Brooklyn, N. Y.: Schedule 2288.—1296 lb. rectangular copper bar. Schedule 2291—47,000 lb. galvanized sheet steel, 4600 lb. lead pipe. Schedule 2293—2700 lb. soft rolled sheet copper, 3000 lb. seamless drawn copper pipe and 13,000 lb. seamless drawn brass pipe, etc. Applications for proposals should designate the schedules desired by number.

LAKELAND, FLA.—Bonds to the amount of $65,000 have been sold by the City of Lakeland, of which the proceeds of $18,000 will be used for improvements to the municipal electric light and water plants.

MILTON, FLA.—The Solomon-Norcross Company, 1622 Candler Building, Atlanta, Ga., has been engaged to prepare plans for the construction of electric light plant, water works and sewer systems, for which bonds to the amount of $40,000 were recently voted.

COLUMBUS, GA.—The Stone & Webster Corporation, of Boston, Mass., which owns and operates the Columbus Power Company, has secured permission from the County Coommissioners of Muscogee County to erect transmission lines along the Chattahoochee River in this county to the Harris County line, where it is reported that another large dam will be constructed across the river at an early date.

DONALSONVILLE, GA.—The proposition to issue $25,000 in bonds for the installation of an electric light plant and water works system will be submitted to a vote.

EDISON, GA.—J. B. McCrary & Company, of Atlanta, Ga., are reported to have been engaged to prepare plans and take charge of construction of the proposed municipal electric light plant, for which bonds to the amount of $8,000 were recently voted. C. J. Jennings is Mayor.

FITZGERALD, GA.—The City Council has renewed the franchise of the Fitzgerald & Ocilla Electric Railroad Company, and it is announced that the proposed railway will be built, contract for construction of the road having been awarded to the American Construction Company, 90 West Street, New York, N. Y. In addition to the interurban service a local street car service will be furnished in Fitzgerald. S. Tilden Holtzendorf, 61 Fifth Avenue, New York, N. Y., and associates were reported to be promoting the project.

SMYRNA, GA.—Plans are being considered by the Atlanta Northern Railway Company for the construction of two substations, one to be located near the river and the other probably at Smyrna. P. S. Arkwright, of Atlanta, Ga., is president.

VIDALIA, GA.—Messrs. Powell & Sneed, of Vidalia, Ga., are reported to be contemplating the development of water power of the Penhoopee River at Gillis Spring, which will be utilized to generate electricity to operate an electric railway.

CAIRO, ILL.—It is reported that the McKinley system is contemplating extensive improvements to its new gas and electric light plant in this city, just completed, which will involve an expenditure of about $200,000. It is also said that the Cairo & St. Louis Railway will be extended from the Cairo end of the line. An announcement has been made that a reduction will be made in the price of electricity for lamps. H. E. Chubbuck is general manager.

CHICAGO, ILL.—The American Sintering Company is contemplating the purchase of equipment for its power plant, including a 300-hp engine and a 200-kw, direct-current generator with auxiliary apparatus.

CHICAGO, ILL.—Bids will be received until March 21 by the Board of Commissioners of Cook County, at the office of William McLaren, superintendent of Public Service, Room 519 Cook County Court House, Chicago, Ill., for furnishing one 15-ton motor hoist, hand operated and controlled traveling crane, to be furnished complete and set upon runaway now in place ready for operation in the power house at the Cook County Infirmary, located at Oak Forest, Ill., in accordance with specifications prepared by Holabird & Roche, architects.

CHICAGO, ILL.—The Commonwealth Edison Comopany has purchased a site for its proposed new power plant on the northwest side of the city, extending west from the north branch of the river between Roscoe and Addison streets and Whipple and Elston streets, on which two generating stations will be erected. Six turbines will be installed in each station, with a rating of 30,000 hp each, making a total of 360,000 hp. Orders have already been placed for two generators with the General Electric Company; which it is expected will be in operation within two years. Holabird & Roche, architects, will design and have charge of construction of the new buildings. Frederick Sargent, of Sargent & Lundy, will have charge of the mechanical part of the station, and the electrical staff of the Commonwealth Edison Comopany will have charge of the electrical work. The plants when completed will represent an investment of $20,000,000. Samuel Insull is president of the company.

BLOOMINGTON, IND.—The Trustees of the Indiana University have awarded the contract for the electrical equipment for the new science building to the Evans Electric Company, of Bloomington, Ind., for $1,884.

BRYANT, IND.—The Fort Wayne & Springfield Railway Company, of Decatur, Ind., has been granted a franchise to construct an electric railway in Bryant. The company has now secured all franchises necessary for its proposed electric railway between Decatur and Portland, Ind. Work on construction of the road will begin early in the spring.

CRAWFORDSVILLE, IND.—The City Council and the Trustees of the municipal electric light plant are considering the question of purchasing energy from the Ben-Hur Traction Company to operate the municipal lighting system. Owing to the condition of the municipal electric plant, it will be necessary to make extensive repairs or rebuild it; an engineer has been engaged to make investigations and submit plans and estimates as to the cost of a new plant and also the feasibility of securing electricity from the traction company.

EVANSVILLE, IND.—Plans have been prepared by the Evansville & Eastern Railway Company for the extension of its railway from Rockport to Grandview, a distance of six miles.

FORT WAYNE, IND.—The Board of Public Works has awarded the contract for a turbo-generator set for the municipal electric plant to the Fort Wayne Electric Works, for $35,139.

FORT WAYNE, IND.—The city engineer and city electrician have been instructed by the Board of Public Works to prepare plans and estimates for the installation of a six-duct conduit in Calhoun Street to provide for the municipal electric light, police and fire alarm wires.

FRANKFORT, IND.—The directors of the Toledo, St. Louis & Western Railway Company are reported to have decided to make extensions and improvements to its shops and plant in Frankfort, which will involve an expenditure of about $250,000, and include the construction of rounohouse, machine shop and coach department and repairing the present buildings. The shops will be equipped for electric motor drive throughout, electricity to be supplied by the municipal electric plant.

GREENFIELD, IND.—The County Commissioners have awarded the contract for the installation of a lighting plant for the county infirmary to the Clark Lighting Company.

HARTFORD CITY, IND.—The City Council has voted to extend the franchise of the Hartford City Lighting Company for a term of 25 years, and the street lighting contract for 10 years, in return for which the company is to reduce the rates of electricity for lamps and motors, and install additional street lamps. The company agrees to build a new plant and install new machinery, which will call for an expenditure of about $25,000.

WAVELAND, IND.—The Town Board is considering the question of establishing an electric light plant.

ALLERTOWN, IA.—The citizens have voted to issue $12,000 in bonds, the proceeds to be used for the construction of an electric light plant.

ANAMOSA, IA.—It is reported that plans are being considered by the Anamosa Electric Light & Power Company for enlarging its plant during the coming year, which will involve an expenditure of about $50,000. The company is now erecting a transmission line to the stone crushing plant of J. A. Green at Stone City for the purpose of furnishing electricity to operate the plant.

LEAVENWORTH, KAN.—The Helmers Manufacturing Company has placed a contract with the Harrisburg Foundry & Machine Company for a 300-hp engine direct-connected to generator for its new power plant. The entire works will be equipped for electric motor drive throughout.

LINCOLN, KAN.—At an election to be held March 24 the proposition to issue $12,000 in bonds, the proceeds to be used to purchase an engine for the municipal electric plant, will be submitted to a vote.

SALINA, KAN.—F. C. Miller, of Kansas City, is reported to have petitioned the City Council for a franchise to operate an electric light and gas plant.

STAFFORD, KAN.—At an election held March 8, the citizens voted to issue $45,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

COVINGTON, KY.—Application has been made to the Board of Aldermen by the Covington & Big Bone Traction Company for a perpetual franchise to construct and operate an electric railway in Covington. The company proposes to build an electric railway between Covington and Big Bone Springs, a distance of 22 miles.

LEXINGTON, KY.—The City Council is considering the question of establishing a municipal electric light plant in Louisville. It is estimated that a plant could be erected at a cost of about $100,000 capable of supplying electricity for between 600 and 700 lamps for about $50 each per year.

OWENSBORO, KY.—The plant and holdings of the Kentucky & Indiana Telephone & Telegraph Company in Davies County was sold March 2 at a receiver's sale to E. H. Cady, of Toledo, Ohio, for $50,000.

RUMFORD, MAINE.—Sealed proposals will be received until April 14 at the office of Charles A. Mixer, engineer of the Rumford Falls Power Company, Rumford, Maine, for construction of additions to power plant, including ledge excavations, masonry cradles for 1000 ft. of 14-ft. penstock, relief pipe concrete spillway; machinery and building excavations and concrete foundations; brick and concrete station building and cofferdam. Plans may be seen after March 21 at the office of the engineer and also at the office of George Burnham, architect, 120 Exchange Street, Portland, Maine.

SANFORD, MAINE.—The question of purchasing the electric plant of the Sanford Light & Power Company and the Springvale Aqueduct Company by the town to be operated by the municipality is reported to be under consideration.

GRAFTON, MASS.—The Grafton Electric Company has petitioned

the State Board of Gas and Electric Light Commissioners for permission to issue $23,000 in additional capital stock, the proceeds to be used to take up outstanding indebtedness.

HOLYOKE, MASS.—The Board of Public Works has decided to abandon the old engine which recently exploded in the Highlands school building, and will use electricity to operate the heating and ventilating fans, which will be furnished by the municipal electric plant.

NEW BEDFORD, MASS.—The directors of the New Bedford Gas & Edison Electric Light Company have voted to increase the capital stock of the company from $845,000 to $1,014,000, the proceeds to be used to pay outstanding indebtedness incurred in making improvements and extensions to the plant and equipment.

STERLING, MASS.—The citizens are considering the question of installing an electric street lighting system. The town has a contract with the Connecticut River Power & Transmission Company by which it agrees to furnish electricity in Sterling, at a much reduced rate in return for a franchise to erect its wires across the streets of the town.

UXBRIDGE, MASS.—The Uxbridge & Northbridge Electric Company has applied to the Board of Gas and Electric Light Commissioners for permission to issue 1680 additional shares of capital stock at $100 per share, the proceeds to be used for additions to its plant and for floating debts.

WESTMINSTER, MASS.—At the annual town meeting to be held during this month the citizens will vote on the proposition to make an appropriation to install an electric street lighting system. The committee is negotiating with the Connecticut River Power Company through the office of the Gardiner Electric Light Company to furnish the service.

DETROIT, MICH.—The Board of Public Lighting Commissioners, 40 Atwater Street, Detroit, Mich., will receive proposals until March 21 for the construction of two brick buildings and auxiliary apparatus for two 400-hp boilers.

HASTINGS, MICH.—Extensive improvements and extensions are contemplated by Thornapple Gas & Electric Company, which furnishes electricity for lamps and motors in Hastings, Middleville, Nashville and Lake Odessa. The cost of the work is estimated at $25,000 and will include the erection of transmission lines from the power house at La Barge to Hastings and the construction of a gas plant in Hastings, also the erection of a new substation to be located near the new gas plant. Plans are being prepared by J. H. Barnard, engineer of New York, N. Y.

IRONWOOD, MICH.—A. E. Appleyard, of Boston, Mass., and associates are interested in the development of Copper Falls, located about 26 miles from Ironwood, where it is estimated that about 3000 hp can be developed. Mr. Appleyard it is understood will petition the City Council for a franchise to furnish electricity in Ironwood. The above parties are also negotiating for the purchase of the properties of the Twin City General Electric Company, which operates the electric light, street railway and water system in Ironwood and Hurley.

LANSING, MICH.—The Michigan United Railways Company is reported to have made a tentative offer for the purchase of the Kalamazoo, Lake Shore & Chicago Railroad, with a view of equipping it for electrical operation through to South Haven and Benton Harbor.

SAGINAW, MICH.—The Saginaw Valley Traction has been granted a 13-year franchise by the City Council to construct a loop in the downtown district.

ANOKA, MINN.—The proposition to bond the city for the construction of a power dam on the Rum River, seven miles above Anoka, will be submitted to a vote. The proposed dam will be 20 ft. in height and of concrete construction, to cost approximately $100,000.

BRECKENRIDGE, MINN.—Preparations are being made by the Wahpeton & Breckenridge Street Railway Company to commence work on the construction of its proposed railway about May 1, for which surveys have been made and right of way secured. The company proposes to build a local street car system in both Breckenridge, Minn., and Wahpeton, N. D., and a railway between the two towns. F. L. Sturm, of Wahpeton, N. D., is general manager.

DULUTH, MINN.—Bids will be received by Charles A. Bronson, clerk of Board of Education, Duluth, Minn., until Mar. 21 for generators, motors and electrical wiring for the Washington Grade and Manual Training School and Central High School. F. G. German, of Duluth, Minn., is architect.

DULUTH, MINN.—Plans are being made by the Duluth Street Railway Company for several extensions and improvements to its West End lines this year, including the construction of the Piedmont Avenue extension and re-laying the Garfield Avenue tracks from the viaduct to interstate bridge. Herbert Warren, of Duluth, Minn., is general manager.

KERHOVEN, MINN.—The installation of an electric light system in Kerhoven, is under consideration by Mr. Irgens.

STILLWATER, MINN.—The Consumers Power Company has acquired the lighting and power plants in Red Wing, Faribault, Albert Lea, White Bear, Owatonna and Mankato. It is understood that the company proposes to utilize the water power in several streams in the towns mentioned above.

ST. LOUIS, MO.—The Independent Packing Company is reported to be considering the construction of a power house to cost about $40,000.

ST. LOUIS, MO.—The Light & Development Company, which is seeking a franchise in St. Louis to compete with the Union Electric Light & Power Company, is preparing plans for construction of an electric plant and distributing plant, which will involve an expenditure of more than $2,000,000. Under the terms of the franchise the company will be compelled to install a plant with an output of at least 4000 kw. The company agrees to furnish electricity for 20 per cent less than the present rates of the Union Electric Company. Hugo Wurbach is president of the Light & Development Company.

HELENA, MONT.—The Montana Rapid Transit Company is reported to have been financed and that work will commence in the near future on the construction of its proposed electric railway between Helena and Butte, via Jefferson City, Corbin, Wickes and Amazon, a distance of 75 miles. The route will be over the old grade of the Northern Pacific Railroad. Electricity for operating the road will be secured from the United Missouri River Power Company. James K. Toole is president.

RALISPELL, MONT.—Surveys have been completed by the Whitefish & Polson Electric Railway Company for its proposed electric railway from Kalispel to Whitefish.

FREMONT, NEB.—The Nebraska Transportation Company has been granted a franchise by the City Council to construct an electric railway in Fremont. The proposed railway will connect Fremont and Omaha. C. W. Baker is president of the company.

OMAHA, NEB.—The City Council is considering the question of a new system of street lamps on 50 blocks, in the city.

SEWARD, NEB.—It is reported that Boyes, Hulshizer & Company are contemplating rebuilding the dam on the Blue River and installing an electric light plant.

FAIRVIEW, N. M.—Plans are being prepared by the Black Range Reduction Works, of Weber (P. O. Fairview), N. M., and bids will be considered for the construction of an aerial tram system, 100-ton milling and cyanidation plant to be operated by electricity (steam generated); also for electric hoists, air compressors, drills, etc., for the gold and silver properties located in the Black Range Mountains.

WILLARD, N. M.—At a mass meeting of farmers held recently in Willard, a committee was appointed to solicit subscriptions for the construction of a central power plant, to cost $45,000, for the purpose of raising water from a shallow depth to irrigate 10,000 acres of fertile land, now without water.

BROOKLYN, N. Y.—Contracts have been placed by the New York & Queens Electric Light & Power Company with the Westinghouse Electric & Manufacturing Company for remodeling its entire switchboard and switching equipment and four 500-kw air-blast transformers.

BROOKLYN, N. Y.—The Public Service Commission has authorized the Coney Island & Brooklyn Railroad Company to issue $151,000 in bonds, to be sold at not less than 80 per cent of the par value and the proceeds to be used to pay for betterments and improvements of the Franklin Avenue and DeKalb Avenue lines and relaying track in Smith Street. The original application of the company asked for permission to issue $372,000.

JAMESTOWN, N. Y.—The Jamestown Light & Power Company is reported to have purchased the Barker property in West Second Street, on which it will erect a distributing station to furnish electricity for commercial lighting in Jamestown. Energy for operating the system will be supplied from the power plant of the Jamestown Electric Street Railway Company. A. N. Broadhead is president of the Jamestown Light & Power Company.

NEW YORK, N. Y.—The contract for furnishing one portable motor-driven air compressor outfit for the Williamsburg Bridge has been awarded to the National Brake & Electric Company, for $2,150. Kingsley L. Martin is bridge commissioner.

NEW YORK, N. Y.—Application will be made to the Board of Estimate and Apportionment on March 18 by the Interborough Rapid Transit Company, the Bronx Traction Company and the Union Railway Company for franchises to build several extensions in Manhattan and The Bronx. The Interborough company proposes to build two extensions, one in the Hunt's Point section and the other from Intervale Avenue, on Dougan Street to Washington Avenue. The Bronx Traction Company contemplates the construction of several extensions and the Union Railway Company is planning a double-track extension from the intersection of Southern Boulevard and Pelham Avenue to the Eastern Boulevard.

NIAGARA FALLS, N. Y.—The Cliff Electrical Distributing Company, organized to distribute the output of the Niagara Falls Hydraulic Power & Manufacturing Company, has applied to the Public Service Commission, Second District, for permission to issue $400,000 in bonds, to be secured by a first mortgage of $1,500,000. The new company will handle the entire output of the power company, with the exception of the amount supplied to the Aluminum Company of America.

WILSON, N. Y.—The Village Board is reported to have entered into a contract with the Bryant & Conaut Company, of Buffalo, N. Y., to furnish electricity for lighting the streets of the village, under the terms of which, the company is to furnish 55 incandescent street lamps and three arc lamps for $1,000 per year. It is understood that the company will furnish electrical service to 100 residences.

ANDREWS, N. C.—The citizens are reported to have voted to issue

$20,000 in bonds, the proceeds to be used to complete the municipal electric light plant and water works. H. N. Wells is Mayor.

HIGH POINT, N. C.—The proposed new cotton mill has been organized under the name of the Pickett Cotton Mills with a capital stock of $250,000. The equipment contemplated for the plant will include 12,000 spindles and 300 looms, to be operated by electricity. Robert L. Steele, of Rockingham, N. C., it is said, will be president.

COLUMBUS, OHIO.—The County Commissioners have granted the Ohio & Southern Traction Company a 20-year franchise to construct an extension from Hartman Farm to Shadeville, a distance of 2½ miles.

NEW CONCORD, OHIO.—Preliminary plans are being prepared by Samuel S. Wyer, engineer, of Columbus, Ohio, for the construction of a municipal electric plant in New Concord. The Village Council has not yet definitely decided to build the plant. It is understood that at least two parties are in the field with propositions to build and operate a lighting system, and if the Village Council can secure a street lighting service at a reasonable price, private ownership of the plant is favored.

PERRYSBURG, OHIO.—We are informed that the former Perrysburg hydraulic canal will be rebuilt and a modern hydroelectric power plant erected. H. von Schon, of Detroit, Mich., is consulting engineer.

TOLEDO, OHIO.—The Toledo Railways & Light Company is contemplating the construction of a new power house at a cost of about $300,000.

FORT SILL, OKLA.—Bids will be received by Captain David L. Stone, constructing quartermaster, Fort Sill, Okla., until April 13, for installing an electric light and power plant and electric lighting system at this post. Specifications, plans and further information will be furnished on application to constructing quartermaster. A deposit of $10 will be required to insure return of plans.

LAWTON, OKLA.—Word has been received from Washington, D. C., that the Senate has passed the bill granting the Lawton & Fort Sill Electric Railway Company right of way through the Military Reservation in Lawton, Okla. Work will commence on construction at once, and it is expected to have the railway completed between Lawton and Fort Sill by June. D. L. Sleeper is vice-president.

WALTER, OKLA.—The question of establishing a municipal electric light plant in Walter is reported to be under consideration. J. O. Dowd is Mayor.

WILBURTON, OKLA.—The McLoud Construction Company, of Kansas City, Mo., has been granted a franchise by the city to construct and operate electric light and gas plants in Wilburton.

CONDON, ORE.—The H. M. Byllesby Company, of Chicago, Ill., has purchased the plant and holdings of the Condon Electric Company, which operates light and power plants in Medford, Grants Pass and Oregon. It is said extensive improvements will be made by the new owners, which will involve an expenditure of more than $250,000.

GREENSBURG, PA.—Plans have been completed by the West Penn Railways Company for the construction of a branch line from Greensburg to the Jamison coke works, and thence to Latrobe, a distance of 10 miles. It is said that the West Newton and Hunter Railway, 20 miles in length, for which rights of way have been secured, will be built this summer.

MILTON, PA.—The Royal Packing Company is reported to be installing an electric light plant.

MONUMENT, PA.—The Harbison-Walker Refractories Company is reported to have awarded the contract for installing a complete electric lighting and power plant in its large brick factory at Monument, to the Clearfield Electric Supply Company, of Clearfield, Pa.

PITTSBURGH, PA.—The West Penn Railways Company is reported to have completed plans for the construction of a 10-mile extension from Greensburg to Latrobe, via Jamison. W. E. Moore, of Connellsville, Pa., is general manager.

PITTSBURGH, PA.—The Carnegie Steel Company is reported to have placed a contract with the Allegheny County Light Company to furnish electricity for its new steel warehouse at Twelfth and Pike streets. Under the terms of the contract the Allegheny company is to furnish 650 hp to operate light electric cranes, shears, punches, lathes, drill and machine shop, and includes 40 flaming arc lamps and other illumination.

POTTSTOWN, PA.—It is reported that the Pottstown & Reading Electric Railway Company will soon commence work on construction of its proposed extension from Sanatoga to Royersford, a distance of about five miles.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company is reported to be contemplating enlarging its power plant at Waynesboro, and the erection of a substation on the mountain similar to the one now in use at Marion. R. D. Sefton, of Waynesboro, is general manager.

DENMARK, S. C.—The plant of the Purity Ice Company is reported to have been purchased by W. D. Garvin, of Savannah, Ga., and G. W. Long, of Townsend, Ga., who, it is said, will remove it from the present location to one within easy access of the Southern and Seaboard Railroad systems, increase the capacity and add an electric light plant. The City Council has granted the company a franchise and has also made arrangements to light the streets with electricity.

RAPID CITY, S. D.—The Rapid City Electric & Gas Company has been granted a franchise to construct and operate an electric plant in Rapid City.

TYNDALL, S. D.—It is reported that plans are being prepared by Oscar Claussen, engineer, 514 German-American Bank Building, St. Paul, Minn., for the proposed new electric light plant for Tyndall. Improvements will also be made to the water works.

NASHVILLE, TENN.—The Capitol Commission has authorized Superintendent Lawyer to advertise for bids for equipment for an electric light plant to be placed in the basement of the building. It is proposed to install a plant with sufficient output to supply electricity to light the capitol building, the annex and grounds.

BAY CITY, TEX.—The Collegeport Telephone Company, recently organized, has applied to the commissioners court for a franchise to erect a telephone line from Collegeport to Bay City.

BRIDGEPORT, TEX.—The Bridgeport Brick Company, recently incorporated, has purchased the plant of the Bridgeport Electric Company and will furnish electrical service in this town. C. W. Martin is president and J. V. Montrief secretary and manager.

BROWNSVILLE, TEX.—B. G. Stegman and associates have applied for a 30-year franchise to construct and operate an electric railway over the principal streets in Brownsville.

BROWNSVILLE, TEX.—At an election held recently the citizens voted in favor of the proposition to issue $30,000 in bonds, the proceeds to be used for improvements and extensions to the local electric light and power plant.

BROWNSVILLE, TEX.—It is reported that the Rio Grande Railroad, which extends from Brownsville to Point Isabel, a distance of 22 miles, will be equipped for electrical operation. The railroad has recently passed into the hands of the Frisco Railroad interests.

DALLAS, TEX.—At an election to be held April 5 the proposition to issue $100,000 in bonds for the construction of an electric light plant will be submitted to a vote. J. M. Preston is city engineer.

NORMANGEE, TEX.—J. A. Parker, of Normangee, Tex., is reported to be in the market for equipment for an electric plant for a small town.

PEARSALL, TEX.—The Pearsall Water, Ice & Light Company, recently incorporated, is planning to construct an electric light plant and water works system, which will include the erection of a building 100 x 40 ft., a steel tower and tank having a capacity of 60,000 gal. and the installation of a 75-kw generator; also a 15-ton ice plant. C. F. Preslar and others are interested in the project.

ROSCOE, TEX.—The construction of an electric light plant in Roscoe is under consideration. B. F. Fitzgerald, of Stanton, Tex., is said to be interested in the project.

BRIGHAM CITY, UTAH.—The Ogden & Northwestern Railroad Company has been granted a franchise in Brigham City, on condition that the railway be completed within one year from acceptance of the franchise.

POULTNEY, VT.—The Rutland Railway, Light & Power Company, of Rutland, Vt., has been granted a franchise through the town of Poultney, in connection with the proposed extension of its railway between Poultney and Fairhaven. An electric line to East Poultney and Fairhaven is also under consideration.

HIGHLAND PARK (P. O. RICHMOND), VA.—The Highland Park Citizens' Association has adopted the resolution requesting the Town Council to make a contract with a private corporation to furnish electricity to light the town. The town for some time has been considering the question of installing a municipal plant, but it has been decided to drop the plan for the present.

HONAKER, VA.—George W. Douglas, of Windber, Pa., is reported to be contemplating the erection of an electric light plant in Honaker.

WINCHESTER, VA.—The Winchester & Washington Railway Company has awarded the contract for the construction of its steam power plant in Winchester to Henry S. Rippel, 1-7 Clay Street, Baltimore, Md. P. O. Keilholtz, Continental Building, Baltimore, Md., is engineer.

ABERDEEN, WASH.—Plans are being prepared by the Grays Harbor Interurban Company for the construction of an electric railway from Aberdeen to Seattle, 87 miles in length, for which 70 per cent of the right of way has been secured. C. C. Quackenbush is interested in the enterprise.

CENTRALIA, WASH.—The J. A. Veness Lumber Company has been granted a franchise by the Board of County Commissioners, to erect and maintain electric transmission lines along the county roads for a term of 25 years.

EVERETT, WASH.—The Seattle-Tacoma Power Company has applied to the Council for a franchise to erect transmission lines on certain streets in Everett.

PORT ANGELES, WASH.—The Port Angeles Power & Electric Company has applied to the City Council for a franchise to furnish electricity for lamps and motors in Port Angeles for a period of 25 years. Under the terms of the franchise the company is to erect a hydroelectric power plant on Little River and to furnish 75 hp. for the municipal electric system in Port Angeles and additional power it may require not exceeding 1000 hp; the company to have the right to use the poles of the city system and the city the use of the company's system, where the city now has none without cost to either party; the company to have the privilege of selling energy for industrial purposes

in amounts of 10 hp and up; the charge not to exceed $50 per hp per year to consumers. The city may at any time purchase the plant of the company on the basis of $100 per hp, the same to be determined by the actual capacity of the plant at peak load at low water in Little River. The city is to pay the company $500 per month for 75 hp, and for additional power used at the rate of three cents per kw-hour. V. R. Bethel and Frank McKean, of Seattle, are interested in the project.

PORT TOWNSEND, WASH.—The City has entered into a new contract with the Citizens Electric Company which calls for the installation of a new lighting system and placing of about 80 new lamps in the residence districts.

RAYMOND, WASH.—The South Bend-Raymond Electric Company is contemplating extending its transmission lines to the section of the city across the South Fork.

SEATTLE, WASH.—Plans have been approved by the Stone & Webster Corporation, of Boston, Mass., for the construction of a hydroelectric power plant at Lake Tapps in Pierce County, where 25,000 hp will be developed for distribution among the Puget Sound cities. The cost of the work is estimated at $2,500,000 and will take two years to complete. The corporation controls and operates the Seattle Electric Company and the Pacific Coast Power Company.

SNOHOMISH, WASH.—The City Council has granted the Seattle-Tacoma Power Company a 25-year franchise to erect transmission lines on certain streets in this city. The lines will carry 35,000 volts, supplying electrical power to the Snohomish and Everett stations from the Snoqualmie plant.

MORGANTOWN, W. VA.—The Union Utilities Company is contemplating the purchase of a 500-kw, low pressure steam turbine, and the construction of two miles of new track in the near future. H. R. Warfield, of Morgantown, W. Va., is general manager.

WELLSBURG, W. VA.—The Wellsburg, Bethany & Washington Railway Company is contemplating extending its railway to Wellsburg and will soon ask for a franchise to construct and operate a street car line in this town. Joseph West is general manager.

WHEELING, W. VA.—The Wheeling Electrical Company has petitioned the City Council for a franchise to erect transmission lines to supply electricity for lamps, heat and power in Wheeling for a term of 50 years.

WHEELING, W. VA.—The Board of Control has awarded a contract for erecting a 20-ton traveling crane and a hand crane of the same capacity to A. W. Wyckoff Company, of Detroit, Mich., subject to approval of the Council.

WILLIAMSON, W. VA.—The electric power plant of the Williamson Light & Ice Company is being enlarged, at a cost of about $15,000, to enable the company to supply electricity for motors. Energy will be furnished to the Williamson Coal & Coke Company and other industrial companies within a radius of several miles.

BLACK RIVER FALLS, WIS.—Bids will be received by E. J. Johnson, city clerk, until March 29 for construction of the municipal electric light plant. The cost of the work is estimated at about $12,000. George Hueshall is chairman of Light, Water and Power Commission.

DELAVAN, WIS.—The Bradley Company is contemplating the construction of a large power house to furnish electricity for lamps and motors for its plant and also for heating the three buildings. The equipment will include a 100-hp engine and a 75-kw generator.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company has been authorized by the Wisconsin Railroad Commission to issue $1,000,000 in bonds, the proceeds to be used for extensions and improvements.

PORTAGE, WIS.—The City Council has granted a franchise to the Chicago & Wisconsin Railroad Company to construct and operate a local street car line, and also to pass through the city in connection with its proposed electric railway, which will extend from Janesville to Merrill. Work will commence on construction of the railway at Portage as soon as the weather will permit; also at Madison and Stevens Point.

BYRON, WYO.—Plans are being made to organize a new company to be known as the Big Horn Water, Light & Power Company, which will be financed by capitalists in Big Horn Basin and Billings. The proposed plant will be located in Byron and it is expected that natural gas will be utilized for fuel. The company proposes to furnish electricity for lamps and motors and water in the towns of Byron, Cowley and Lovell. Norman S. Poole is promoter of the company.

WETASKIWIN, ALTA., CAN.—A by-law appropriating $5,000 for improvements and extensions to the municipal electric plant will be submitted to a vote of the people. E. Roberts is secretary and treasurer.

WINNIPEG, MAN., CAN.—The Board of Control is reported to have decided to call for tenders for the construction of a substation at McPhillips Street, at a cost of $50,000, together with the reconstruction of a conduit system from that point to the station at Point Douglas, the cost of which is estimated at about $50,000.

WINNIPEG, MAN., CAN.—The Board of Control has recommended to the City Council the award of the tender for the equipment of the power terminal station to the Canadian Westinghouse Company, for $116,500; for installation of light, heat and power systems to Chapman & Walker, of Toronto, Ont., for $8,225; the erection of oil and water system to the Canadian Fairbanks Company, for $6,482. No bids were received for the water cooling tower and accessories, the specifications being general in character. Detailed designs will be prepared and tenders called again.

TORONTO, ONT., CAN.—The Hydroelectric Power Commission has received two additional municipal contracts for Niagara power. The Town of Norwich proposes to take 150 hp for $30 per hp per year, and the Town of Tilsonburg has applied for 500 hp at $30.50 per horsepower per year, the difference in price is due to the length of transmission line between the two municipalities. The towns will be supplied by a feeder line from Woodstock. The transmission line will be a low-tension distribution, which will enable service to be rendered to farmers along the route, who may wish to avail themselves of the opportunity to obtain electrical service.

MONTREAL, QUE., CAN.—The Montreal Street Railway Company has applied to the City Council for a franchise to double-track certain sections of its system where single track has been laid, and also for extension on thoroughfares which have not had tracks. About 13 miles of track will be built.

SHERBROOKE, QUE., CAN.—The Sherbrooke Electric Railway & Power Company, recently formed, has obtained an option on the property of the Sherbrooke Street Railway Coompany and has applied to the City Council for a 20-year franchise and tax exemption for a term of 20 years. An election will be held March 21 to vote on the by-law. The company proposes to make extensive improvements and extensions to the property, involving an expenditure of about $600,000, and includes developing a water power on Magog River, construction of 12 miles of track within the city limits, and extensions to surrounding towns and villages, aggregating 18 miles.

New Industrial Companies.

THE AMERICAN VEHICLE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $2,000 to manufacture and deal in motors, engines, machines, etc.; also to manufacture and deal in automobiles and autocycles. The incorporators are: Francis H. McKnight, Malcolm D. Simpson, Frederick W. Stevens, and others of New York, N. Y. The office of the company is located at 23 Wall Street, New York, N. Y.

THE BUILDERS' ELECTRIC COMPANY, of Atlanta, Ga., has been incorporated with a capital stock of $5,000 by William T. Proctor and W. A. Alexander. The company proposes to deal in electrical supplies.

THE ELITE GAS & FIXTURE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $3,000 to manufacture and deal in gas and electrical fixtures, etc. The incorporators are: Eugene E. Tachudy, Irving Tachudy and Henry A. Schmidt, all of New York, N. Y.

THE FARKAS METALLIC FILAMENT & LAMP COMPANY, of New York, N. Y., has been chartered by C. L. Wilson, J. Fromme and F. W. Baldwin, of New York, N. Y. The company is capitalized at $75,000, and proposes to conduct in laboratories experiments in tungsten lamps, manufacture lamps and lamp filaments, etc.

THE HUB MACHINE WELDING & CONTRACTING COMPANY, of Philadelphia, Pa., has been chartered with a capital stock of $100,000. The new company will take over the Hub Machine & Tool Company and the Mechanical Manufacturing Company, and will manufacture Acme metal saw table and other tools, electric welding and general machine work. The officers are: B. F. Lare, president; E. E. Pennock, vice-president, and Robert Morris, secretary and treasurer.

THE INDIANA POWER COMPANY, of Indianapolis, Ind., has been incorporated with a capital stock of $25,000 as general manufacturers. The directors are: C. L. Schmidt, F. W. West, J. M. Stuart, George E. Moore, W. Dickerson, Albert Thompson, D. A. Johnson, R. B. Spillman and J. R. Raub.

THE KETTLES IMPROVED COUPLING COMPANY, of Gary, Ind., has been incorporated with a capital stock of $25,000, for the purpose of manufacturing electrical couplings, mechanical couplings and electrical and mechanical supplies. The directors are: James V. Kettles, William C. Crolius and Alfred Jones.

THE NEW IDEAL VACUUM CLEANER COMPANY, of Portland, Maine, has been granted a charter with a capital stock of $1,000,000 for the purpose of manufacturing and dealing in vacuum and other cleaning machines. The officers are C. E. Eaton, president, and T. L. Croteau, treasurer, both of Portland, Maine.

THE STANDARD ELECTRIC WIRING COMPANY, of Kansas City, Mo., has been chartered with a capital stock of $4,950 by O. J. Forriss, Walter Flemming and John T. Dysart.

THE TELAUTOPHOTE COMPANY, of New York, N. Y., has been incorporated by Sidney Rothschild, of New York, N. Y.; Benjamin Rosenberg and Joseph A. L. Gardner, both of Brooklyn, N. Y. The company is capitalized at $50,000, and proposes to deal in electrical apparatus and to construct telephone lines.

THE TUBULAR CONSTRUCTION COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing machinery, etc., by L. Atwood, of Farmington Falls, Maine; and C. N. King, of Jersey City, N. J.

New Incorporations.

McGEHEE, ARK.—The Desha Light, Water & Manufacturing Company has been chartered with a capital stock of $50,000 for the purpose of establishing an electric lighting system in McGehee, and other purposes. The officers are: T. J. Wooodward, president; C. E. Woodward, vice-president; E. F. Curran, secretary.

LOS ANGELES, CAL.—The Fullerton & Richfield Railway Company has been incorporated with a capital stock of $130,000 to construct and operate an electric railway between Fullerton and Richfield. The incorporators are: A. G. Wells, G. Holterhof, Jr., W. H. Brewer, J. L. Hibbard and C. W. Jones.

DENVER, COL.—The Southwestern Operating Company has been incorporated with a capital stock of $30,000 by W. J. Barker and others. It is understood that the company has been organized as a holding company to take over gas and electric plants in the cities in the southwestern part of the country.

ATLANTA, GA.—The Paulding County Power Company has been chartered with a capital stock of $40,000 by J. R. Gordon, R. L. West, J. M. Sheffield, E. Davis and W. O. Hitchcock.

GRIFFIN, GA.—Articles of incorporation have been filed for the Griffin City & Suburban Railway Company by H. H. Basse, J. P. Nichols, B. R. Blakely and others. The company is capitalized at $25,000 and proposes to construct and operate a street car system in Griffin. About five miles of track will be laid.

WARWICK, GA.—The Flint River Power Company has filed articles of incorporation with a capital stock of $1,000,000, for the purpose of constructing a hydroelectric power plant at Warwick, Ga. The incorporators are: D. G. Zeigler, of Jacksonville, Fla.; E. W. Fenn, of Worth County, Ga., and John Burck, of Lee County, Ga.

CAIRO, ILL.—Articles of incorporation have been filed for the Terre Haute & Cairo Interurban Railway by C. Carroll Boggs, of Fairfield, and James R. Campbell, of McLeansboro, Ill. The proposed railway will be equipped for both passenger and freight traffic.

McLEANSBORO, ILL.—Articles of incorporation have been filed for the Illinois Oil & Coal Belt Railway Company, with a capital stock of $1,000,000, to construct an electric railway to connect Terre Haute, Ind.; Robinson, Olney, Fairfield, McLeansboro and Cairo, Ill., 190 miles in length. The officers are: J. R. Campbell, of McLeansboro, Ill., president; Joseph W. Crowley, of Robinson, Ill., vice-president; Isaac H. Webb, of McLeansboro, Ill., secretary; J. H. Lane, of McLeansboro, Illl., treasurer, and Allen G. Russell, manager, of Chicago, Ill.

SPRINGFIELD, ILL.—The Springfield Traction Company has been chartered with a capital stock of $10,000 to construct and operate an electric railway from Springfield to Pana and Vandalia through Sangamon, Montgomery and Fayette counties. The incorporators are: Ernest H. Heimle, George B. Gillespe, A. M. Fitzgerald and George Riordan, of Springfield, Ill., and C. E. Hazlett, of Rochester, Ill.

STREATOR, ILL.—The Streator Heat & Light Comopany has been chartered with a capital stock of $25,000 to operate a light, heat and power plant. The incorporators are: D. Heenan, J. Mannix and N. P. Breen, of Streator, Ill.

CLINTON, IA.—Articles of incorporation have been filed for the Iowa & Illinois Railway Terminal Company for the purpose of constructing and operating railroads by electricity or other motive power in the State of Iowa and other states. The capital stock is placed at $25,000 and the officers are: F. W. Ellis, president and treasurer; Henry Thuenen, Jr., vice-president and assistant secretary, and P. P. Crafts, secretary and assistant treasurer.

CLEGHORN, IA.—The Liberty Central Telephone Company has filed articles of incorporation with a capital stock of $450,000. The company is already established and operating exchanges. J. H. Lowry is president.

MARENGO, IA.—The Marengo Electric Light & Power Company has been incorporated with a capital stock of $15,000 for the purpose of installing an electric light and power plant in Marengo.

BAXTER SPRINGS, KAN.—The Oklahoma-Kansas Railway Company has been chartered by Dr. Charles M. Jones, E. B. Morgan, M. C. Harper and Charles L. Smith. The company is capitalized at $200,000 and proposes to construct an electric ralway from Galena, Kan., to Hattonville, Okla., via Baxter Springs, Kan., through the lead and zinc fields. The proposed railway will be 23 miles in length.

GLASGOW, KY.—Louisville, Lincoln Farm & Mammoth Cave Traction Company has been incorporated to construct and operate an electric railway from Hodgenville and Glasgow, a distance of 50 miles, by L. W. Preston, J. C. Preston, J. A. McDaniel, J. F. Taylor and J. L. Williams.

LEWISTON, MAINE.—Articles of incorporation have been filed for the Nye Lighting & Heating Company with a capital stock of $50,000. The officers are: J. B. Marcotte, president, and Dana S. Williams, treasurer and clerk, both of Lewiston, Maine.

MOTLEY, MINN.—Articles of incorporation have been filed for the Motley Telephone Company with a capital stock of $10,000. The officers are: V. Lockwood, president, and S. W. Jacobs, secretary and treasurer.

ROLLING FORK, MISS.—The Shark County Improvement Association has filed articles of incorporation with a captial stock of $5,000 for the purpose of establishing a water system, an electric light plant and ice plant. The officers are: D. C. Casey, president; J. E. Meek, secretary and treasurer, and G. W. Bell, manager.

LIBERTY, MO.—Articles of incorporation have been filed for the Liberty Electric Light & Power Company by Washington B. Walker, Harry Walker and Lillie D. Walker. The company is capitalized at $50,000.

MAYFLOWER, NEB.—Articles of incorporation have been filed for the Kinkaiders Mutual Telephone Company with a capital stock of $6,000.

ENGLEWOOD, N. J.—Articles of incorporation have been filed for the Central Home Telephone & Telegraph Company by John Heck, of Westwood, N. J.; Garrett Z. Demarest, of Demarest, N. J., and Le Roy VanderBurgh, of Hackensack, N. J. The company is capitalized at $20,000.

JERSEY CITY, N. J.—The Southern Iowa Traction Company has filed articles of incorporation with a capital stock of $300,000 for the purpose of constructing and operating railroads. The incorporators are: J. R. Turner, S. A. Anderson, and H. O. Coughlan, of Jersey City, N. J.

JERSEY CITY, N. J.—The General Transmission Company has been incorporated by H. Lieber, W. W. Gooch, H. Page, Dr. H. Schweitzer and J. R. Turner, of Jersey City, N. J. The company is capitalized at $100,000 and proposes to operate a system for the transmission of intelligence or sound in any method or manner by wires or by wireless communication.

TRENTON, N. J.—The Trenton Power Company has been incorporated with a capital stock of $310,000 to operate water, gas and electrical plants, etc. The incorporators are: J. DeW. Duncan, of Philadelphia, Pa.; H. F. Price, and J. Fry, of Trenton, N. J.

ALBUQUERQUE, N. M.—The citizens' Traction & Power Company has been organized for the purpose of constructing an electric street railway in Albuquerque, N. M. The officers of the company are. A. W. Hayden, president; D. H. Boatright, vice-president; Isaac Barth, secretary, and J. C. Baldridge, treasurer.

SANTA FE, N. M.—The Levisa Creek Coal, Coke & Power Company has been incorporated with a capital stock of $2,000,000. The directors are: T. J. Wood, W. L. Afexander, W. J. Filbert, T. T. Kerr, C. T. Berrymore, all of Oklahoma City, Okla., and Charles F. Easley, of Santa Fe, N. M.

GLENS FALLS, N. Y.—The Mills Power Company has been incorporated with a capital stock of $50,000. The directors are James H. Cross, of Johnstown, N. Y.; Theodore D. Cross, of Sandy Hill, N. Y., and J. Ward Russell, of Glens Falls, N. Y.

RUTHERFORDTON, N. C.—The Isothermal Traction Company has been chartered with a capital stock of $100,000 for the purpose of constructing and operating an electric railway from Rutherfordton to Gastonia. The incorporators are: K. S. Finch, of Charlotte, N. C.; J. F. Flack, W. A. Harrill, E. B. Harris and C. F. Geer, of Rutherfordton, N. C.

ALVA, OKLA.—The Winters Light Company has been granted a charter with a capital stock of $10,000. The incorporators are: G. W. Winters, Walter Winters, of Alva, Okla., and H. B. Winters, of Cora, Okla.

CHICKASHA, OKLA.—The Chickasha Street Railway Company has been chartered with a capital stock of $150,000 to construct a railway in Chickasha and into parts of Grady County. The proposed railway will be six miles in length. The directors are: Charles F. Woodward, W. Raymond Emerson, of Wakefield, Mass.; Lawrence Martin, R. D. Welborne and W. P. Weston, of Chickasha, Okla.

MUSKOGEE, OKLA.—The Eastern Oklahoma Traction Company has been incorporated with a capital stock of $100,000 to construct an electric railway from Muskogee to Tulsa, 48 miles in length; a branch to Wagoner, 9 miles; from Wagoner to the Grand River, 10 miles; Tulsa to Sapulpa, 14 miles; Muskogee to Webber's Falls, 23 miles; Muskogee to Checotah, 21 miles; Muskogee to Okmulgee, 39 miles; Okmulgee to Oklahoma City, 87 miles, making a total of 251 miles. The directors are: H. B. Spaulding, R. N. Eggleston, J. W. Mattoz, L. B. Kershaw, W. L. Tull, J. B. Furry and Guy Bowman, of Muskogee, Okla. An auxiliary company, to be known as the Railway Construction Company, has been chartered with a capital stock of $50,000 and the following named directors: R. N. Eggleston, W. R. Robinson, L. R. Kershaw and J. B. Furry, of Muskogee, and W. P. Keegan, of Tulsa, Okla.

ROLL, OKLA.—The Roll Telephone Company has been incorporated by J. E. McKinney, D. W. Snider and Perry Maddin.

FOUNTAIN SPRINGS, PA.—The Fountain Springs Telephone Company has been organized with a capital stock of $5,000. The company proposes to erect telephone lines between Fountain Springs, Frackville and Gordon, and will connect with the American Union Telephone Company's system at Reading. The officers are: C. Alex. Seitzinger, president, and Thomas Richards, treasurer.

HOMESTEAD, PA.—The Homestead & Mifflin Street Railway Company has been incorporated to construct an electric railway. The officers of the company are: F. J. Erbeck, president; J. Merrill Wright, vice-president; Robert McWhinney, secretary; J. B. Coen, treasurer, and Ralph C. Davis, superintendent.

LOYSVILLE, PA.—The Sherman's Valley Light, Heat & Power Company has been incorporated with a capital stock of $5,000 by G. E. Ness, of York, Pa., and W. J. Glatfelter, of Spring Grove, Pa., and others.

SCRANTON, PA.—The Scranton & Binghamton Traction Company has been incorporated with a capital stock of $10,000 to construct and operate an electric railway from Binghamton, N. Y., to Scranton, Pa., a distance of 62 miles. W. L. Connet, of Scranton, Pa., is president.

HENNING, TENN.—The Henning Electric Light & Ice Company has been organized to establish electric light and ice plants in Henning. The officers are: S. M. Ray, president; Robert S. Porter and John D. Tarrant, vice-presidents, and Joseph B. Alston, manager.

AUSTIN, TEX.—The United Telephone Company, of Austin, has filed articles of incorporation with a capital stock of $300,000 for the purpose of taking over the properties of the Austin Independent Telephone Company, the Williamson County and the Bell County Telephone companies, which have been in the hands of receivers. The incorporators are: I. B. Cameron, H. N. Dougherty, of Columbus, Ohio; James S. Brailey, of Toledo, Ohio; W. D. Hart and George W. Allen, of Austin, Tex.

BROWNWOOD, TEX.—The Brownwood Southwestern Railway Company has been chartered by R. A. Love, of Kansas City, Mo.; H. T. Love, Brooke Smith, B. E. Hulbert, D. F. Johnson, of Brownwood; J. C. Kerby, John L. Smith, A. J. Eilers, Louis Davis and F. M. Covert, of Austin, Tex. The company is capitalized at $30,000 and proposes to construct an electric railway from Brownwood through Brown and Coleman counties to a point four miles north of Colorado River, a distance of 30 miles.

COLLEGEPORT (P. O. PALACIOS), TEX.—The Collegeport Telephone Company has been chartered with a capital stock of $5,000 by M. A. Nelson, Theodore Smith and Karl Smith.

ELGIN, TEX.—The Elgin Light & Power Company has been chartered with a capital stock of $15,000 by Thomas L., Louis C., and Peter A. Deisch.

GREENVILLE, TEX.—The Eastern Texas Traction Company has been chartered for the purpose of constructing and operating an extensive system of interurban electric railways, which will radiate from Greenville, where the principal offices of the company will be located. The entire system will embrace more than 250 miles. It is expected that active construction work will commence this spring. The incorporators are: J. B. Murphy, J. H. Blocker, H. E. Vaughn, W. M. McBride, H. C. Tittsworth, G. A. Coulson, J. Riley Green, S. B. Perkins, J. H. Myrick, R. N. White, L. N. Byrd and Joseph F. Nichols.

MARBLE FALLS, TEX.—The Colorado River Power Company has filed its charter with the Secretary of State, with a capital stock of $1,000,000. The company has completed a large dam across the Colorado River at Marble Falls, 35 miles above Austin, and proposes to construct a hydroelectric power plant to supply electricity in Marble Falls and erect transmission lines to Austin and other towns. From 2000 to 4000 hp will be developed. C. H. Alexander, of Dallas, Tex., is at the head of the company.

McALLEN, TEX.—The McAllen Ice & Power Company has been incorporated with a capital stock of $15,000 by R. S. Pershing, R. E. Pershing and Albert Simmons.

SNYDER, TEX.—The Snyder Ice & Electric Company has been organized by W. A. Fuller, E. W. Clark, Arthur Yange, and others. It is understood that the company will consolidate and enlarge the electric light and ice plants.

CAVENDISH, VT.—Articles of incorporation have been filed with the Secretary of State for the Cavendish Electric Light Company, with a capital stock of $5,000, by the Gay Brothers.

LYNCHBURG, VA.—Articles of incorporation have been filed for the Hudson-Morgan Electric Company with a capital stock of $10,000. The officers are: Q. Hudson, president, and Peyton L. Morgan, secretary and treasurer.

FAIRMONT, W. VA.—The Fairmont & Pittsburgh Railway Company has been incorporated with a capital stock of $1,000,000 to construct an electric railway from Fairmont to Blacksville, Waynesburg and Pittsburgh; also from Fairmont to Mannington, Blacksville, Morgantown, and along the Monongahela River back to Fairmont. The incorporators are: William M. Laws, of Jersey City, N. J.; H. F. Smith, J. R. Linn, S. E. Miller, of Fairmont, and J. F. Beatty, of Mannington, W. Va.

Personal.

MR. E. T. KULAS, vice-president of the Central Station Development Co., Cleveland, sailed for Europe on March 12 for a much-needed rest. He will return the first week in April.

MR. A. B. KRATZ has been appointed acting superintendent of telegraphs and telephones for the Panama Railroad of the Isthmian Canal Commission, succeeding Mr. J. Beaumont, who has resigned.

MR. FREDERICK W. HUNTINGTON has begun a series of five lectures on "Electricity and Magnetism," to be delivered during March and April under the auspices of the Department of Education of the City of New York.

MR. H. LINTON REBER, general manager of the Kinloch Long-Distance Telephone Company, the holding corporation of the Kinloch Telephone Company, St. Louis, was elected vice-president and general manager, at a meeting last week of the directors of the holding company.

MR. W. H. MERRILL, manager of the Underwriters' Laboratories of Chicago, was the guest of honor at a luncheon in Denver attended by 30 representatives of the largest business interests of that city. Mr. Merrill gave a brief talk on conservation by reduction of the fire waste.

MR. H. THURSTON OWENS, consulting engineer, New York City, recently delivered a lecture under the auspices of the New York City Board of Education on "Street Lighting." This lecture is to be repeated on the evening of March 30 at Public School No. 186, 145th Street, west of Eighth Avenue.

MR. J. R. SLOAN, electrician of the motive power department of the Pennsylvania Railroad Company, delivered an address before the Central Railway Club in Buffalo on March 11, in the course of which he expressed the opinion that in the near future all steam equipment operated in passenger service will be electrically lighted.

DIRECTOR W. WALLACE KER, of the Hebrew Technical Institute, will deliver a special course of six lectures on "Principles and Practice in Electrical Engineering," beginning on March 26, and ending April 30. The lectures are part of the public courses offered by the Department of Education of the City of New York.

MR. JOHN W. ESKHOLME has been appointed manager of the Chicago office of the Garwood Electric Company, of Garwood, N. J. Mr. Eskholme, who has his office in the Old Colony Building, has had considerable experience in the electrical business, but more recently has been connected with the exploitation of gasoline-electric motor cars for railways.

MR. FRANK H. BERNHARD, editor of the *Electrical Review and Western Electrician* of Chicago, who has been in an unsatisfactory state of health for some time, is taking a long rest to recover his strength. Mr. Bernhard was formerly an assistant professor at Armour Institute of Technology, Chicago. His friends will hope that he will be entirely successful in seeking restored health and vigor.

MR. R. G. BLACK, general superintendent of the Toronto Electric Light Company, Limited, addressed the salesmen of the company March 10 on "Transformers." The meetings of the salesmen are held daily, from 8:30 to 9:30 a. m. and during the first half hour routine business is given attention, while the last half of the session is devoted to listening to some speaker prominent in his profession, who may volunteer to address the men.

MR. WILLIAM A. TURBAYNE, formerly electrical engineer with the Gould Storage Battery Company and the Gould Coupler Company of Depew, N. Y., has accepted a position with The United States Light & Heating Company of Maine as special engineer in connection with storage battery and car lighting work. Mr. Turbayne has been long identified with the progress of regulating apparatus, and will devote a large part of his time to the development of a number of systems.

MR. JOHN C. PARKER, whose appointment as non-resident lecturer on electric power, transmission and distribution at the University of Michigan was announced in last week's issue, was born in Detroit, Mich., in 1879. He graduated from the mechanical engineering course of the University of Michigan in 1901, specializing in mathematics and physics the following year for a master's degree. After his post-graduate work was completed, he entered the testing department of the General Electric Company, and subsequently occupied the position of instructor in the newly formed electrical engineering school of Union College at Schenectady. During this period Mr. Parker took in absentia from his alma mater a graduate degree of electrical engineer, presenting as a thesis a mechanical conception of dynamo-electric machinery. From Union College he went to Niagara Falls as assistant to the engineer in charge at the plant of the Ontario Power Company. As assistant to Mr. F. B. H. Paine, vice-president and engineer of the Iroquois Construction Company, he had much to do with the construction of the transmission line of the Niagara, Lockport & Ontario Power Company and designed and installed the system of receiving and substations for delivering 60,000-volt Niagara energy to the Lackawanna Steel Company. Thereafter he became mechanical and electrical engineer for Mr. Paine and designed the transmission line, transformer station and substation for bringing Niagara energy to Rochester, N. Y., and utilizing it for railway service. Since 1907 Mr. Parker has been connected with the Rochester Railway & Light Company as mechanical and electrical engineer in charge of hydraulic investigations and transmission designs, and the general functions of the engineering department. He organized the industrial engineering work of the Rochester company, and has devoted much time during the last four or five years to the study of general economics for power generation, distribution and sale. Mr. Parker has done consulting work in hydraulic and general economic problems; is editor of the N. E. L. A. Question Box; member of the A. I. E. E., A. S. M. E. and associate of the A. S. C. E. His lectures at the University of Michigan are on general economic features of distribution, as well as technique

MR. JOHN C. PARKER.

MR. C. C. BRADFORD, who has been identified with the New York Office of The United States Light & Heating Company as manager of the sales department, has been transferred to the Cleveland office, to take up the work of Mr. A. B. Weil, who has resigned. Mr. Bradford goes to a territory with which he has long been familiar, owing to the fact that Cleveland is his home city. He will cover the States of Ohio, West Virginia, Kentucky, part of Indiana, Michigan and Pennsylvania.

MESSRS. E. W. RICE, JR., vice-president; *J. R. LOVEJOY,* vice-president, and *W. L. R. EMMETT,* electrical engineer, of the General Electric Company, Schenectady, N. Y., were in Chicago last week on business in connection with the proposed new North Side generating station of the Commonwealth Edison Company. On the evening of March 8 the visitors were entertained at dinner at the Chicago Club by Mr. Samuel Insull, president of the Commonwealth company, who had also as his guests on that occasion some of the other officers of the Commonwealth company.

MR. C. A. GREENIDGE has become connected with J. G. White & Company as engineer, operating department. After graduation from Stevens Institute in 1895, Mr. Greenidge became assistant to engineer in the office of Ernest Flagg, architect, and the following year was assistant, as chief tester, to the superintendent of the Mount Morris Electric Company. From 1898 to 1902 he was assistant superintendent of the First District of the New York Edison Company, and during this period made special investigations in central station economics, fuel testing, engine adjustments, etc. In 1902 he become resident engineer in charge of steam electric plant construction of the Equitable Gas & Electric Company, of Utica, N. Y. Later he was made superintendent of the electrical department of the company, then general manager, which position he resigned in order to accept his present one.

Obituary.

DR. WILLIAM MERRICK GRAY, pathologist at the army medical museum in Washington and an authority on X-ray treatment, dropped dead on March 9, in his laboratory while engaged in X-ray experimentation. Examination by physicians and the coroner revealed that he had succumbed to heart disease. Dr. Gray was 57 years old.

Trade Publications.

TRANSFORMERS.—Bulletin No. 1118 of the Fort Wayne Electric Works, Fort Wayne, Ind., deals with shell-type transformers rated at from 0.6 kw to 50 kw.

UNDERGROUND CONDUIT CONSTRUCTION.—The American Conduit Company, manufacturers of bituminized fiber conduit, 140 Nassau Street, New York, has recently issued a booklet on underground conduit construction for electric light and telephone work, which includes many diagrams and much information of value to all contemplating underground conduit construction.

RAILWAY SIGNAL VOLT-AMMETER.—In these days of automatic railway signals the thorough testing of such signals is absolutely necessary. For this purpose the General Electric Company has designed a volt-ammeter, which it describes in its Bulletin No. 4714. This instrument is arranged for four combinations, so that two voltage ranges and two current ranges or three current ranges and one voltage range can be obtained.

ILLUMINATION DATA.—"How to Figure Illumination" is the title of an attractive bulletin just issued by the Western Electric Company. It treats in a comprehensive manner of the lighting of interiors and gives useful information in connection with Sunbeam "Mazda" lamps. Anyone without even an elementary knowledge of illuminating engineering can easily figure the illumination required for any space by use of the tables and data given.

ORNAMENTAL STREET LIGHTING.—Bulletin No. 4689 of the General Electric Company is devoted to the subject of ornamental street lighting. While the installations to which reference is made in this publication consist of the old style tungsten lamps, they will be gradually changed, the old style lamps being replaced with the "Mazda" lamp, which contains a tungsten filament and represents the most recent development in high efficiency metal filament lamps.

OIL-BREAK SWITCHES.—Because of the safety, reliability and flexibility of the oil switch, it has, within recent years, been adopted for the control of practically all alternating-current circuits using e.m.f.'s of 440 volts or over. Bulletin No. 4713 of the General Electric Company describes its Type F, Forms K-2 and K-4 oil switches, and states their rupturing capacities. It contains diagrams of connections of these switches, and will be found of general interest to central-station managers and engineers.

ELECTRIC LIGHT FIXTURES.—The Western Electric Company has recently issued an attractive booklet showing a complete line of lighting fixtures known as Hawthorn "Mazdaliers." The anti-jar link suspension, a protective device which adds to the life of the tungsten filament by eliminating all vibration and jar, is shown in detail. The booklet is well illustrated with cuts showing the construction of the different parts of the "Mazdaliers," and the descriptive matter gives detailed information regarding those parts as well as features of installation.

SMALL ELECTRIC LIGHTING OUTFITS.—The Richardson Engineering Company, Hartford, Conn., describes in Bulletin No. 35 special outfits suitable for farms, cottages and isolated residences. These outfits comprise a switchboard, gasoline engine, belted generator and storage battery and are designed for the average house 20 ft. x 40 ft. and two stories high. The necessary fixtures and glassware together with wires, low-voltage tungsten lamps, etc., are a part of the outfit, which, with the instructions accompanying it, can be set up by a person of average intelligence.

SMALL PLANT ALTERNATING-CURRENT SWITCHBOARDS.—Those contemplating the installation of a small plant containing only one exciter and one generator should find the General Electric Company's Bulletin No. 4711 of considerable interest. The publication treats of panels designed only for such service, no provision being made for operating generators in parallel, although the instrument equipment is suitable for balanced or unbalanced loads. The bulletin lists panels for two-phase and three-phase circuits, shows the connection diagrams for such panels and gives dimensions and ratings.

RAILWAY MOTOR.—To the practical railway man Bulletin No. 4715, issued by the General Electric Company and describing the company's 70-hp, 600-volt railway motor, should be of considerable interest. The motor is of substantial construction and has brush-holder and field-coil supports. It is practically sparkless, even on heavy overloads. In this motor the flashing at the commutator is largely reduced; the motor is especially clean and reliable; armature heating low, and the efficiency and free-running capacity high. The bulletin enters into a detailed description of this motor and contains a speed table, characteristic curves and dimension diagrams.

BUSINESS NOTES.

THE HURLEY MACHINE COMPANY has opened a retail store and showroom at 31 Monroe Street, Chicago, between State Street and Wabash Avenue, for the display of its Thor electric laundry machines.

THE L. J. WING MANUFACTURING COMPANY has opened a company office at 84 State Street, Boston, Mass., which will be in charge of Mr. A. E. Seelig, E. E., New England manager, where a stock of "Typhoon" turbine blowers will be carried. Mr. Seelig will be pleased to receive catalogs.

RICHARD A. TURNER & COMPANY.—Mr. Richard A. Turner, who has had charge of the electrical wiring department of Fred T. Ley & Company, Springfield, Mass., since its establishment, has arranged to purchase the interests and good-will of this department, and in the future conduct same under the firm name of Richard A. Turner & Company, electrical engineers and contractors, with headquarters in the Phœnix Building, Springfield.

THE AMERICAN ELECTRIC FUSE COMPANY, Muskegon, Mich., has secured the services of Mr. C. R. Underhill, the well-known authority on the design and construction of electromagnets, on which subject he is the author of a standard treatise and numerous articles contributed to the technical press. The American Electric Fuse Company is a pioneer in the manufacture of enameled wire, and to demonstrate fully the possibilities of this wire a coil-winding department has been organized, of which Mr. Underhill will have charge.

THE WRIGHT WRENCH MANUFACTURING COMPANY, of Canton, Ohio, has let contracts for a large modern factory. The new plant will be located in South Canton on two lines of railroad and will embrace about three acres of ground. Two buildings will be erected, one of brick and one of steel construction, which together will have a floor space of over 13,000 sq. ft. The machinery will be modern, much of it especially designed for them, and they will employ over double the number of men. With the increased equipment the company expects to have a capacity for 2000 wrenches a day. The new factory, which will be ready for occupancy May 1, will be one of the most complete of its kind in the country.

THE CUTLER-HAMMER MANUFACTURING COMPANY'S Chicago office in the Monadnock Building, in charge of Mr. R. M. Van Vleet, is to be considerably enlarged to meet the increasing demands of the business. A new feature will be the installation of an intercommunicating telephone system connecting not only the various offices, but also the stock room on the seventeenth floor of the building. The machinery and apparatus of the J. L. Schureman Company, purchased by the Cutler-Hammer Company, will be moved to the Milwaukee headquarters of the latter company, and Mr. S. M. McIredries, formerly connected with the Schureman company, but now with the Cutler-Hammer company, will hereafter make his headquarters in Milwaukee.

WESTINGHOUSE TURBINES AND CONDENSERS.—The Citizens' Railway & Light Company, at Muscatine, Ia., has recently added a 750-kw Westinghouse turbo-generator set for its local light, power and railway service. A rotary converter set makes available direct current for the latter purposes. The condensing system is of the Leblanc jet type, manufactured by the Westinghouse Machine Company. The Maryland Steel Company has just installed, in connection with its low-pressure steam turbine generating equipment, a Westinghouse-Leblanc 18 condenser at its Sparrows Point, Md., plant. Direct current at 250 volts is supplied by the low-pressure turbine generating set, which is operated as an auxiliary to Westinghouse engine-driven equipment, effecting a considerable addition to the plant output without requiring additional steam generating apparatus.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 8, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street, N. Y. City.]

951,147. IDENTIFIABLE CABLE CONDUCTOR; A. B. Porter, Chicago, dec'd. App. filed June 16, 1906. Marks are printed upon the insulating covering before making up the conductors into the cable, after which the core is given a protecting cover.

951,159. ELECTRIC LIGHTER; W. Voltz, Chicago, Ill. App. filed July 22, 1909. For house use, in which the handle contains a magnet coil and has a lighting tip contact, and a non-magnetic rod is centered in the coil and extends to the contact and carries an armature which breaks the contact.

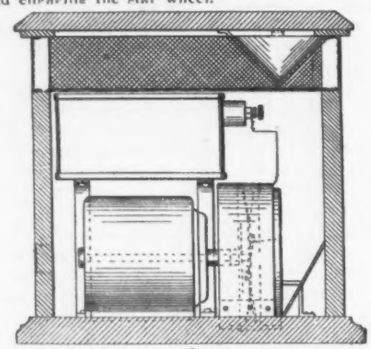
951,190. TELEGRAPH ARM; M. Lachman, New York, N. Y. App. filed Jan. 26, 1909. A metal arm carrying pin insulators by means of a flange, the pin projecting laterally through openings in the flange.

951,228. METHOD OF DECOMPOSING SALTS; J. Whiting, Boston, Mass. App. filed Dec. 16, 1908. Electrolytically decomposes salts by passing an electric current through an electrolyte to a still body of liquid metal acting as a cathode, and transfers said body by gravity to a region of oxidation and returns the metal to the region of electrolytic decomposition.

951,229. ELECTROLYTIC CELL; J. Whiting, Boston, Mass. App. filed Dec. 16, 1908. An apparatus for the process of 951,228 in which the cell has a liquid metal cathode, an outlet for the cathode, controlling means therefore with means operating at intervals for actuating the controlling and means for returning the liquid metal to the decomposing cell.

951,232. PROCESS OF FORMING ELASTIC ANCHORS FOR INCANDESCENT LAMP FILAMENTS; H. W. Bresler, Charlottenburg, Germany. App. filed May 20, 1909. Fuses fine round wire into a glass support and flattens the wire while in place to produce elasticity.

951,259. ELECTRICAL-CIRCUIT PROTECTOR; C. A. Rolfe, Adrian, Mich. App. filed Dec. 1, 1902. A heat cartridge provided with a self-soldering star wheel and a strip spring secured at one end with its free end engaging the star wheel.



951,443—Ozonizer.

951,265. MEANS FOR ELECTROPLATING PIPE, ETC. L. A. Williams, Evanston, Ill. App. filed June 19, 1908. A tank for electroplating rods or pipes in which the rods are supported, the current passing through the anode, the electrolyte and the rods, the latter being rotated and moved longitudinally.

951,287. ELECTRIC TOASTER; L. F. Parkhurst, Pittsfield, Mass. App. filed Nov. 20, 1908. For toasting or broiling by radiant electric heat in which a resistance wire is mounted vertically in the frame on a skeleton support provided with terminals for the wire and baskets enclose the wire into which the bread is slipped.

951,305. MULTIPLE FUSE BLOCK; C. H. Dunfee, Denver, Col. App. filed June 12, 1908. Two horizontal cylinders are geared together to rotate and carry in the periphery of each a number of longitudinal grooves open at the surface and holding fuses which lie parallel with the axis of the cylinders.

951,311. METHOD OF PURIFYING WATER ELECTROLYTICALLY; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. For purifying water electrolytically by means of a current which flows between metallic electro plates generating ozone which acts on the impurities.

951,312. CONTROL-VALVE MECHANISM FOR ELECTROLYTIC WATER PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. For automatically breaking and making the circuit to the electrodes when the liquid is turned off or on.

951,313. ELECTROLYTIC WATER PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. The current flows alternately and equally between aluminum plates and the ozone generated acts on the impurities. A circuit breaker and maker controlled by the flow of liquid retard the breaking of the circuit until after the liquid ceases to flow.

951,314. ELECTRODE BOX FOR LIQUID PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. Includes a plurality of removable vertical electrode plates which intercept the passage of the liquid through the box, causing it to flow in a zigzag course, and a removable cover sealing the box and holding the plates in position, with a flushing outlet underneath the plates.

951,315. CURRENT-REVERSING AND CONTROL MECHANISM FOR LIQUID PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. Circuit-reversing mechanism for liquid purifying apparatus, including a reversing switch and a motor actuated by the flow of the liquid for actuating the reversing switch periodically during the flow of the liquid.

951,347. ELECTRIC SNAP SWITCH; G. E. Stevens, Lynn, Mass. App. filed Oct. 7, 1909. A snap switch including a stationary cam spindle carrying contacts, a coil spring encircling the spindle and means for moving the spring along the spindle.

951,354. STRAIN INSULATOR; M. M. Wood, Chicago, Ill. App. filed Sept. 15, 1905. The insulator has an insulated body, a metallic cup thereon with an internal groove, a plate in the cup with a beveled corner opposite the groove, a retaining ring sprung into the groove and engaging the corner.

951,365. PRODUCTION OF METALLIC PAPER OR THE LIKE; S. O. Cowper-Coles, Westminster, London, England. App. filed Feb. 28, 1908. A thin sheet of copper is electro-deposited on a slowly revolving metallic drum arranged in a vat, the surface of the drum being plain or engraved with any desired ornamentation.

951,400. SUPPORT FOR INCANDESCENT-LAMP FILAMENTS; A. S. Knight, Newark, N. J. App. filed July 19, 1909. The lamp has a terminal with an X-shaped looped end.

951,411. LIGHTNING PROTECTOR FOR BUILDINGS; J. P. A. Anderson, Madrid, Ia. App. filed March 12, 1906. The roof eaves and spouts serve as lightning protectors and carry conducting wires and are grounded.

951,443. OZONIZER; O. Linder, Chicago, Ill. App. filed Jan. 14, 1910. For ozonizing air by a high-voltage discharge by means of a rotary fan whose vanes constitute one electrode and an opposed electrode with its face in the path of the vanes of the fan electrode, with a thin dielectric or annulus in contact with the opposed electrode.

951,446. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed March 27, 1909. An electric cut-out including a box containing a fuse with circuit connections and a longitudinal slidable switch in the box.

951,455. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; J. J. Rooney, New York, N. Y. App. filed Jan. 5, 1910. An insulating base, a metallic sleeve in the base and having a rigid terminal, an insulating block secured to the projecting end of the sleeve and a terminal strip with contact screw.

951,458. ELECTRIC FURNACE AND METHOD FOR OPERATING SAME; J. F. Shawhan, Dayton, Ohio. App. filed June 16, 1909. Passes a current of air over an electric arc formed between a set of electrodes and then passes the heated air into the hearth chamber of a furnace.

951,505. INSULATING TUBE; T. T. Mather, Egg Harbor City, N. J. App. filed Oct. 14, 1909. Two half pipes clamp an electric conductor between them and insulate it.

951,524. WIRELESS CONTROLLING DEVICE; C. L. Coleman, San Leandro, Cal. App. filed Jan. 25, 1909. For starting or stopping suitable motors for guarding submarines, etc. Details.

951,546. RESONANT CAB-SIGNALING SYSTEM; H. D. Patterson, Mount Vernon, N. Y. App. filed Sept. 28, 1908. Cab system in which a source of alternating potential is carried in the cab provided with a train-controlling device and a train-electromagnetic device is suspended over the track, together with a track electromagnetic device positioned in the path of the traveling field of the train device. A traffic-controlled normally resonant circuit at the track is closed through the track device.

951,583. AUTOMATIC FIRE-ALARM SIGNAL. F. E. Schultz, Detroit, Mich. App. filed April 9, 1909. A fire-alarm signal to be used with the plug of an electric fuse box, the signal being started by a thread or fusible wire. Details.

951,601. CIRCUIT CHANGER; P. J. Doyle, Chicago, Ill. App. filed April 7, 1909. For the flasher type of electric signs, including a driving gear wheel, a driven wheel, the former being connected to the source of electric supply and the latter having its toothed rim made of insulated sections with individual terminals connected thereto and spring tongues attached thereto and giving contact with the driving gear.

951,622. TROLLEY RETRIEVING DEVICE; G. W. Snow, Holyoke, Mass. App. filed Feb. 2, 1909. A spring-pressed catch becomes operative when the trolley cord is placed under tension as by the upward movement of the trolley pole and pulls the connected cord down so as to pull the trolley wheel below the wire.

951,623. RELAY; A. E. Stevens, Fall River, Mass. App. filed March 16, 1908. Two relays are mounted side by side, being the line and cut-off relays of a telephone system. They are combined in a unit on the base on which two sets of contact springs are carried, as well as jacks for electrical connections.

951,631. ELECTRICAL TEST IMPLEMENT; V. H. Dake, Buffalo, N. Y. App. filed Nov. 19, 1908. For testing cables by means of a holder having contact points to provide a large contact area without making a large single perforation, each point perforating the insulation separately.

951,640. AUTOMATIC ELECTRIC RAILWAY SIGNAL; J. Friedlander and M. Pecar, Gary, Ind. App. filed June 1, 1909. For protecting crossings by means of pairs of brushes suitably spaced apart on each of the four sides of the crossing, which brushes contact with rails carried by the train, thus closing a signal circuit.

951,662. ELECTROPLATING BARREL APPARATUS; T. A. Smith and T. Deakin, Walsall, England. App. filed Sept. 25, 1909. The tank contains inclined rotatable work holders driven at their lower ends.

951,732. TEMPERATURE REGULATOR MOTOR; C. E. Jewell, Auburn, N. Y. App. filed June 21, 1905. The motor drives a damper and is controlled by a thermostat.

951,750. AUTOMATIC TIME SWITCH; P. J. Stuparich, San Francisco, Cal. App. filed March 16, 1909. For automatically turning off the light in apartment houses by means of an automatic time switch which does not interfere with the lighting of the lamp, but turns it out after five minutes or so.

951,765. ELECTRIC TOASTER; J. I. Ayer, Cambridge, Mass. App. filed Oct. 26, 1909. The heating element is enclosed against the passage of air currents so as to contain the heat. Makes use of an upright unit protected on opposite sides by grids and enclosed by wide end walls and overhanging top.

951,788. ELECTRO ADJUSTABLE CONDENSER; H. Gernsback, New York, N. Y. App. filed Jan. 9, 1909. A number of Leyden condensers for wireless telegraphy, etc., mounted in a frame with a conductor at the upper side, separate conductors at the bottom and springs for supporting the condensers or jars between the opposite sides and the frame.